

TITLE OF THE INVENTION

CONTENT DUPLICATION MANAGEMENT SYSTEM AND NETWORKED APPARATUS

This application is based on an application No.  
5 2002-249241 filed in Japan, the content of which is hereby  
incorporated by reference.

BACKGROUND OF THE INVENTION

(1) Field of the Invention

10 The present invention relates to technology to manage  
duplication of contents in the use of the contents in a networked  
environment.

(2) Description of the Related Art

15 Conventionally, there are several known techniques to  
restrict unlimited duplication of contents. One example is  
copy generation management that prohibits copy or duplication  
of a duplicated content (a third generation duplication).  
Another example is disclosed in Japanese unexamined patent  
20 application publication No. 2000-357213 that requires mutual  
authentication be performed between a transmitting end and a  
receiving end and allows duplication of a content according  
to the authentication result.

The above copy generation management technique and the  
25 one disclosed in the above publication gazette are mainly applied  
to a system composed of a recording apparatus and a recording  
medium. Examples of such a recording apparatus include a

personal computer and a recorder, while examples of such a recording medium include a DVD and an SD card. In such a system, a recording apparatus collectively manages control information used, for example, to restrict the number of times contents  
5 can be duplicated.

Unfortunately, however, the above conventional techniques involve problems as described below when applied to contents distribution via a network.

Suppose, for example, contents are used in a home network  
10 environment in which a plurality of devices are mutually connected. In this case, a recording apparatus is the only apparatus that manages control information used, for example, to restrict the number of times each content can be duplicated. Consequently, in order to duplicate a content, all the other  
15 devices need to make a request to the recording apparatus, and then receives the content from the recording apparatus. In other words, any content cannot be transmitted unless the recording apparatus is the transmitting end. Such usage of contents in a home network environment is inconvenient for users,  
20 thereby failing to meet the users' need for high usability

#### SUMMARY OF THE INVENTION

The present invention is made in view of the above problems and aims to provide a highly-convenient content duplication  
25 management system which allows users to freely duplicate contents as long as it is in compliance with the given usage right.

To achieve the object stated above, one aspect of the present invention provides a networked apparatus that belongs to a group and that is connected via a network to at least one device in the group and to at least one device out of the group.

- 5      The networked apparatus: stores a content; receives from a device, a duplication request for the content; judges whether the device is in the group or out of the group; and duplicates the content to the device if judged to be in the group, and imposes restrictions on duplication of the content to the device if  
10     judged to be out of the group.

With the above-stated structure, the networked apparatus prevents unlimited duplication of the content as well as unauthorized distribution of the content to an out-group device.

- Here, the networked apparatus may store duplication  
15     restricting information that is attached to the content. The duplication restricting information shows (i) a permitted number representing right to duplicate the content, and (ii) restrictions to be imposed on duplication of the content to a device that is out of the group. The networked apparatus  
20     may control duplication of the content based on the duplication restricting information.

- With the above-stated structure, the networked apparatus controls duplication of the content based on the duplication  
25     restricting information attached to the content. This arrangement eliminates the need to store the duplication restricting information collectively in the networked apparatus.

Here, each device that is in the group may be one of a first type device that records a content to a non-portable recording medium and a second type device that records a content to a portable recording medium. The permitted number may be  
5 a sum of a permitted number of duplications to a first type device and a permitted number of duplications to a second type device. If the device issued the duplication request is judged to be in the group, the networked apparatus may judge whether the device is a first type device or a second type device, and  
10 control duplication of the content based on the judgment and the duplication restricting information.

With the above-stated structure, the networked apparatus is capable of controlling duplication of the content to a device in the group based on whether the device is a first type or  
15 a second type device.

Here, each device that is in the group may belong to at least one subgroup. The networked apparatus may store in advance a first table showing whether duplication of the content from a subgroup to another subgroup is permitted. If the device  
20 issued the duplication request is judged to be in the group, the networked apparatus may judge to which subgroup the device belongs, and control duplication of the content based on the judgment, the duplication restricting information, and the first table.

25 With the above-stated structure, the networked apparatus is further capable of controlling duplication of the content to a device in the group based on the subgroup to which the

device belongs.

Here, if the device issued the duplication request is judged to be in the group, the networked apparatus may transmit to the device, information showing a permitted number that is equal to or smaller than the stored permitted number so as to transfer at least part of the right to duplicate the content, and if the device issued the duplication request is judged to be out of the group, the networked apparatus may refuse to perform the transmission to the device.

With the above-stated structure, the networked apparatus transmits a permitted number that is equal to or smaller than the permitted number of duplications that is held by the networked apparatus so as to transfer at least part of the right to duplicate the content. Accordingly, the sum of the permitted numbers held by all the devices in the group remains constant at all times. In other words, the devices in the group are allowed to duplicate the content only within the originally given permitted number.

Here, the networked apparatus may transmit to the device issued the duplication request, the content attached by duplication restricting information that includes the permitted number showing the number equal to or smaller than the originally permitted number.

With the above-stated structure, the networked apparatus transmits to the device issued the duplication request, the content together with the duplication restricting information showing the permitted number that is equal to or smaller than

the permitted number held in the networked apparatus. On receiving the content, the request source device is permitted to duplicate the content to another device the number of times shown by the duplication restricting information attached to 5 the received content. With a networked apparatus as above, it is possible to construct a system that is more convenient for users in comparison with a system in which, for example, a server device collectively manages a permitted number of duplications.

10 Here, the networked apparatus may store secret information that is also stored in all devices that is in the group, and may judge that the device issued the duplication request is in the group if the device has the secret information, and otherwise judges that the device is out of the group.

15 With the above-stated structure, all the devices in the group share the secret information, so that the networked apparatus is allowed to judge whether the device issued the duplication request is in the group or out of the group.

Here, the networked apparatus may: generate a first  
20 permitted number of duplications; generate a second permitted number of duplications by subtracting the first permitted number from the permitted number that is currently stored; transmit the first permitted number and the content to the device issued the duplication request so as to transfer at least part of the right to duplicate the content; and overwrite the permitted number with the second permitted number.

With the above-stated structure, what is transferred to

the device judged to be in the group is a part or all of the right to duplicate the content represented by a permitted number that is smaller than or equal to the permitted number held in the networked apparatus. That is to say, the sum of the permitted numbers held in all the devices in the group remains constant at all times. As a result, the devices in the group are allowed to duplicate the content in such a manner not exceeding the permitted number of duplications that is originally given.

Here, the duplication request may be composed of a requested number of duplications of the content. The networked apparatus may judge whether the stored permitted number is equal to or greater than the requested number, and designate, if the judgment is affirmative, the requested number as the first permitted number, and designates, if the judgment is negative, the permitted number as the first permitted number.

With the above-stated structure, each device is allowed to request an intended number of duplications. Further, the networked apparatus compares the requested number with the permitted number held in the networked apparatus so as to transfer the right to duplicate the content the number of times not exceeding the permitted number of times. As a result, the devices in the group are allowed to duplicate the content only within the permitted number of times that is originally given.

Here, each device that is in the group may be one of a first type device that records a content to a non-portable recording medium and a second type device that records a content to a portable recording medium. The permitted number may be

a sum of a permitted number of duplications to a first type device and a permitted number of duplications to a second type device. The duplication request may be composed of a requested number of duplications of the content to a first type device  
5 and a requested number of duplications of the content to a second type device. The networked apparatus may judge whether each of the two permitted numbers are equal to or greater than a corresponding one of the two requested numbers, and designate, if the judgment is affirmative, a sum of the two requested numbers  
10 as the first permitted number, and designate, if the judgment is negative, a sum of the two permitted numbers as the first permitted number.

With the above-stated structure, the networked apparatus is capable of controlling duplication of the content to a device  
15 in the group in accordance with whether the device is a first type device or a second type device.

Here, each device that is in the group may belong to at least one subgroup. The networked apparatus may: store a first table showing whether duplication of the content from a subgroup  
20 to another subgroup is permitted; judge with reference to the first table whether duplication of the content to the device issued the duplication request is permitted; and generate the first permitted number if the judgment is affirmative.

Also, the networked apparatus may further store a second table showing subgroup identifiers each associated with an upper limit to a permitted number that is possibly held in total by devices belonging to a subgroup identified by a corresponding

subgroup identifier. The duplication request may include a subgroup identifier identifying a subgroup to which the device issued the duplication request belongs. The networked apparatus may generate the first permitted number with reference  
5 to the second table.

With the above-stated structure, duplication of the content between devices in the group may be restricted. For example, suppose that the group represents a home network, it is possible to restrict duplication of prohibit a device located  
10 in a child's room to duplicate a TV program that is not considered suitable for children. Similarly, it is possible to prohibit a device located in a library to duplicate a children's program.

Here, the networked apparatus may transmit to the device issued the duplication request , the first and second tables  
15 together with the content and the first permitted number.

With the above-stated structure, the networked apparatus transmits the content together with information relating to subgroups. This arrangement eliminates the need for all the devices in the group to store such information in advance.

20 Here, the networked apparatus may further clock a date-and-time, and store a predetermined date-and-time and a post-update permitted number. When the date-and-time clocked reaches the predetermined date-and-time, the networked apparatus may update the stored permitted number by overwriting  
25 with the post-update permitted number.

With the above-stated structure, it is possible to update the permitted number of duplications at the predetermined

date-and-time.

Here, the networked apparatus may further clock a date-and-time, and store a predetermined date-and-time and information identifying a device to which the content is to be duplicated. When the date-and-time clocked reaches the predetermined date-and-time, the networked apparatus may transmit, to the identified device, the content together with a permitted number that is equal to or smaller than the stored permitted number so as to transfer at least part of the right to duplicate the content.

With the above-stated structure, duplication processing may be performed at a predetermined date-and-time, which allows a user to program the apparatus to duplicate the content at a scheduled time.

Here, if the device issued the duplication request is judged to be out of the group, the networked apparatus may transmit to the device the content together with right to play back the content.

With the above-stated structure, the networked apparatus transmits the content to a device out of the group with right to play back the content but without right to duplicate the content. Accordingly, unlimited distribution of the content is prevented.

In another aspect of the present invention, the present invention provides a content duplication management system including a first device that belongs to a group and a second device connected to the first device via a network. The first

device: stores a content and a permitted number representing right to duplicate the content; receives from the second device, a duplication request for the content; judges whether the second device belongs to the group; and transmits to the second device  
5 if judged to belong to the group, information showing a permitted number that is equal to or smaller than the stored permitted number so as to transfer at least part of the right to duplicate the content, and refuses to perform the transmission to the second device if judged to be out of the group. The second  
10 device: transmits to the first device, a duplication request for the content; and receives from the first device to store the content and the permitted number of duplications.

With the above-stated structure, the content duplication management system protects the content from unlimited distribution to a device out of the group, while allowing  
15 duplication of the content to a device in the group only within the permitted number of duplications.

Here, content duplication management system may further include a plurality of devices that belong to the group. The  
20 first device may further transmit to each of the devices, detection information used to detect the requested content. Each of the devices may receive the detection information and perform a search based on the detection information to judge whether there is the requested content stored within the device.

25 With the above-stated structure, the content duplication management system is capable specifying all devices each of which is in the group and stores a desired content.

#### BRIEF DESCRIPTION OF THE DRAWINGS

These and the other objects, advantages and features of the invention will become apparent from the following 5 description thereof taken in conjunction with the accompanying drawings which illustrate a specific embodiment of the invention.

In the drawings:

Fig. 1 is a block diagram showing an overall structure 10 of a group formation/management system 1;

Fig. 2 is a block diagram showing a structure of an AD server 100;

Fig. 3 shows a structure of registration information;

Fig. 4 is a block diagram showing a structure of a playback 15 apparatus 200;

Fig. 5 is a block diagram showing a structure of an on-vehicle device 300;

Fig. 6 is a block diagram showing a structure of an IC card 400;

20 Fig. 7 is a flowchart showing SAC establishment processing (cont. in Fig. 8);

Fig. 8 is a flowchart showing SAC establishment processing (cont. from Fig. 7);

25 Fig. 9 is a flowchart showing operations by which AD server 100 registers playback apparatus 200;

Fig. 10 is a flowchart showing operations by which AD server 100 registers on-vehicle device 300;

Fig. 11 is a flowchart showing operations by which AD server 100 registers on-vehicle device 300;

Fig. 12 is a flowchart showing operations to deliver a content;

5 Fig. 13 is a flowchart showing part of the operations to deliver a content;

Fig. 14 is a flowchart showing operations to record a content onto a DVD;

10 Fig. 15 is a flowchart showing operations to withdraw from AD server 100;

Fig. 16 is a block diagram showing a structure in which a representative device representing a plurality of client devices registers in an AD server 600;

15 Fig. 17 shows conceptually the formation of a single group from a plurality of groups;

Fig. 18 shows conceptually the division of a single group to form a plurality of groups;

FIG. 19 is a view showing a structure of a content duplication management system 1000;

20 FIG. 20 is a block diagram showing a structure of a home server 1100;

FIG. 21 is a view showing a data structure of content information 1121;

25 FIG. 22 is a view showing functional blocks of a control unit 1104;

FIGS. 23A and 23B are views showing data structures of content information 1125 and 1127, respectively;

FIGs. 24A and 24B are views showing data structures of content information 1150 and 1153, respectively;

FIG. 25 is a block diagram showing a structure of a playback apparatus 1200;

5 FIG. 26 is a view showing functional blocks of a control unit 1202;

FIG. 27 is a view showing a data structure of content information 1162;

10 FIG. 28 is a block diagram showing a structure of a playback apparatus 1300;

FIG. 29 is a view showing functional blocks of a control unit 1302;

FIGs. 30A and 30B are views showing data structures of content information 1172 and 1182, respectively;

15 FIG. 31 is a block diagram showing a structure of a recording medium 1400;

FIG. 32 is a flowchart showing operations performed by content duplication management system 1000, and to be continued onto FIGs. 33 and 35;

20 FIG. 33 is the flowchart continued from FIG. 32 and to be continued onto FIG. 35;

FIG. 34 is the flowchart continued from FIG. 33; and

FIG. 35 is the flowchart continued from FIG. 32.

25 DESCRIPTION OF THE PREFERRED EMBODIMENT

An embodiment of the present invention will now be described in detail with reference to the drawings.

GROUP FORMATION/MANAGEMENT SYSTEM 1

<Structure of Group Formation/Management System>

As shown in Fig. 1, a group formation/management system  
5 1 is structured from an authorized domain (AD) server 100, a  
playback apparatus 200, an on-vehicle device 300, an IC card  
400, and a DVD 500.

AD server 100 and playback apparatus 200, which is  
connected to a monitor 251 and a speaker 252, are disposed in  
10 a user's home and are connected online. On-vehicle device 300  
is mounted in a vehicle owned by the user. IC card 400 and DVD  
500 are connectable to AD server 100 and on-vehicle device 300.  
IC card 400 is affiliated with AD server 100, and AD server  
100 only operates when IC card 400 is connected thereto.

15 Group formation/management system 1 is a system in which  
AD server 100 manages an authorized domain (AD), being a range  
within which content usage is permitted.

AD server 100 receives and manages the registration of  
client devices, and AD server 100 and registered client devices  
20 share common secret information (CSI) generated by AD server  
100. Mutual authentication using shared CSI is conducted among  
devices within the same authorized domain, and when  
authorization is successful, transmission/reception, copying  
and the like of contents is conducted among these devices.  
25 Because the CSI differs between authorized domains, devices  
not holding the CSI of the authorized domain managed by AD server  
100 cannot transmit/receive or copy contents available within

the authorized domain of AD server 100.

Playback apparatus 200 is connected to AD server 100 and is thus able to conduct authentication and to register as a client device. Also, on-vehicle device 300, although not 5 connected to AD server 100, is able to register as a client device by having CSI stored on IC card 400 and notifying the CSI from IC card 400 to on-vehicle device 300.

### 1.1 Structure of AD Server 100

10 As shown in Fig. 2, AD server 100 is structured from a control unit 101, a secret-key storage unit 102, a public-key-certificate storage unit 103, a CRL storage unit 104, a public-key-encryption processing unit 105, a registration-information storage unit 106, a CSI generation 15 unit 107, a CSI storage unit 108, a content storage unit 109, an encryption unit 110, an ID storage unit 111, a drive unit 112, an input unit 113, a display unit 114, an input/output (IO) unit 115, an input/output (IO) unit 116, a decryption unit 117, a content-key storage unit 118, and an encryption unit 20 119.

AD server 100 is specifically a computer system structured from a microprocessor, a ROM, a RAM, a hard disk unit and the like. A computer program is stored on the RAM or the hard disk unit. AD server 100 carries out functions as a result of the 25 microprocessor operating in accordance with the computer program.

AD server 100 conducts processing to register devices,

manage copying of CSI and withdrawals, deliver contents, and copy contents.

Each of the elements will now be described.

5 (1) IO Unit 115, 116, Drive Unit 112

IO unit 115 conducts transmission/reception of data with playback apparatus 200. IO unit 116, when the connection of IC card 400 is detected, outputs the detection to control unit 101. Also, IO unit 116 conducts transmission/reception of data 10 with IC card 400. Drive unit 112 writes/reads data to/from DVD 500.

(2) Secret-Key Storage Unit 102, Public-Key-Certificate Storage Unit 103, CRL Storage Unit 104, Content Storage Unit 109, ID Storage Unit 111, Content-Key Storage Unit 118

15 ID storage unit 111 stores an *ID\_1*, which is an identifier (ID) unique to AD server 100.

Public-key-certificate storage unit 103 stores a public key certificate (PKC) *Cert\_1*.

PKC *Cert\_1* certifies that a public key *PK\_1* is the legitimate public key of AD server 100. PKC *Cert\_1* includes signature data *Sig\_CA1*, public key *PK\_1*, and *ID\_1*. Signature data *Sig\_CA1* is generated by a certification authority (CA) performing a signature algorithm *S* on public key *PK\_1* and *ID\_1*. Here, a CA is a reliable third party authority, and issues public 25 key certificates certifying the legitimacy of the public keys of devices belonging to group formation/management system 1. Moreover, signature algorithm *S* is, as one example, an ElGamal

signature over a finite field. Since ElGamal signatures are known technology, a description is omitted here.

Secret-key storage unit 102 is a tamper-resistant area that cannot be viewed from outside, and stores a secret key 5 SK\_1 corresponding to public key PK\_1.

CRL storage unit 104 stores a certificate revocation list (CRL). A CRL is a list, issued by a CA, in which are registered the IDs of invalidated devices, which are devices that have conducted improper processing, devices whose secret key has 10 been disclosed, and the like. Moreover, it need not be device IDs that are registered in a CRL, but may be the serial numbers of public key certificates held by invalidated devices. A CRL is distributed to devices, for example, via a broadcast, the Internet or stored on a recording medium such as DVD, and devices 15 obtain the most recent CRL. Moreover, a detailed discloser of CRLs can be found in the American National Standards Institute's ANSI X9.57: "Public Key Cryptography for the Financial Services Industry: Certificate Management," 1997.

Content storage unit 109 stores encrypted contents 20 encrypted using content keys. Moreover, although the method of acquiring contents is not the subject of the present invention and a description is thus omitted here, acquisition methods include, for example, acquiring contents using the Internet, broadcasts or the like, or acquiring contents from a recording 25 medium such as a DVD.

Content-key storage unit 118 receives an encrypted content key a from encryption unit 110, and stores the encrypted

content key  $a$ .

(3) Public-Key-Encryption Processing Unit 105

Public-key-encryption processing unit 105 conducts authentication at a time of communicating with another device, and establishes a secure authenticated channel (SAC). A SAC refers to a safe communication channel that enables encrypted communication. As a result of processing to establish a SAC, it is possible to confirm that the device being authenticated is a legitimate device recognized by the CA. A detailed description of the SAC establishment method is given later. Also, unit 105, as a result of the authentication, shares a session key  $SK$ .

15 (4) Registration-Information Storage Unit 106

Registration-information storage unit 106 is a tamper-resistant area, and stores registration information as shown in Fig. 3A. Registration information is information for managing the number of devices registerable in AD server 100 and the ID of registered devices, and is structured from DEVICE ID, MAXIMUM, REGISTERED, REMAINING, and IC CARD ID.

DEVICE ID is an area storing the ID of devices registered in AD server 100. When playback apparatus 200 and on-vehicle device 300 are registered in AD server 100, an  $ID_2$  and an  $ID_3$ , 25 being the respective IDs of devices 200 and 300, are stored, as shown in Fig.3B.

MAXIMUM shows the maximum number of devices registerable

in AD server 100, the maximum number being two in the present embodiment. REGISTERED shows the number of devices already registered in AD server 100. REMAINING shows the remaining number of devices registerable in AD server 100.

5        In an initial state in which no client devices are registered in the authorized domain managed by AD server 100, the registered number (REGISTERED) is "0", and the remaining number (REMAINING) has the same value as the maximum number (MAXIMUM). When a client device is registered in the authorized  
10 domain by AD server 100, "1" is added to the registered number, and "1" is subtracted from the remaining number.

IC CARD ID prestores the ID of IC card 400 affiliated with AD server 100, and cannot be rewritten.

15 (5) CSI Generation Unit 107, CSI Storage Unit 108

CSI storage unit 108 is a tamper-resistant area storing a CSI that cannot be read from outside, and stores, when no devices are registered in AD server 100, "0" as a value showing that no devices are registered.

20        CSI generation unit 107 generates CSI when a device is initially registered in AD server 100, under the control of control unit 101. Also, when all of devices withdraw, CSI storage unit 108 rewrites the stored value to "0".

Here, CSI is arbitrary data generated by CSI generation  
25 unit 107, and has a 200-bit length in the present embodiment. Moreover, the bit length of the CSI is not limited to this, and may be any length that is not readily estimatable, and that

cannot be easily tested.

CSI generation unit 107 stores generated CSI in CSI storage unit 108. Also, unit 107 outputs generated CSI to IC card 400 when connected.

5 Moreover, CSI may be updated regularly or irregularly.

(6) Encryption Unit 110, Encryption Unit 119

Encryption unit 119, at a time of playback apparatus 200 being registered and under the control of control unit 101, 10 performs an encryption algorithm  $E$  on CSI using a session key  $SK$  received from public-key-encryption processing unit 105 to generate encrypted CSI, and transmits the encrypted CSI to playback apparatus 200 via IO unit 115. Here, encryption algorithm  $E$  is, as one example, a Data Encryption Standard (DES) 15 algorithm. Since DES algorithms are known technology, a description is omitted here.

Encryption unit 110, at a time of storing a content key in content-key storage unit 118, reads  $ID\_1$  from ID storage unit 111 and reads CSI from CSI storage unit 108. Unit 110 20 concatenates the read  $ID\_1$  and CSI in the stated order to generate an encryption key  $a$ , performs an encryption algorithm  $E$  on the content key using encryption key  $a$  to generate encrypted content key  $a$ , and outputs encrypted content key  $a$  to content-key storage unit 118.

25 Encryption unit 110, at a time of writing an encrypted content onto DVD 500 and under the control of control unit 101, reads  $ID\_2$  and  $ID\_3$ , which are the IDs of the registered devices,

from DEVICE ID of the registered information in registration-information storage unit 106. Unit 110 concatenates *ID\_2* and CSI in the stated order to generate an encryption key *b*, and concatenates *ID\_3* and CSI in the stated 5 order to generate an encryption key *c*. An encrypted content key *b* and an encrypted content key *c* are generated respectively using encryption key *b* and encryption key *c*, and written to DVD 500.

10 (7) Decryption Unit 117

Decryption unit 117, under the control of control unit 101, reads *ID\_1* stored in ID storage unit 111 and reads CSI stored in CSI storage unit 108. Unit 117 performs a decryption algorithm *D* on encrypted content key *a* read from content-key 15 storage unit 118, using a decryption key generated by concatenating the read *ID\_1* and CSI in the stated order, to obtain a content key. Unit 117 outputs the obtained content key to encryption unit 110. Here, decryption algorithm *D* is an algorithm for conducting the reverse processing of encryption 20 algorithm *E*.

(8) Control Unit 101, Input Unit 113, Display Unit 114

Input unit 113 receives inputs from a user, and outputs the received inputs to control unit 101.

25 At a time of starting processing, control unit 101, on receipt of an IC card ID from connected IC card 400, confirms whether the received ID matches the IC card ID in the registration

information. If not matched, control unit 101 displays on display unit 114 the fact that the connected IC card is not the IC card affiliated with AD server 100, and ends the processing. If matched, control unit 101 continues the processing as follows.

5           Registration of Playback Apparatus 200

On receipt of a registration request from playback apparatus 200 via IO unit 115, control unit 101 controls public-key-encryption processing unit 105, and establishes a SAC using a CSI initial value "0", by the SAC establishment method to be described later (here, the CSI initial value "0" used at a time of registration indicates that playback apparatus 200 has yet to be registered). From the result of the device authentication at a time of establishing the SAC, control unit 101 judges whether the target device has an authorized public key pair and whether the target device is unregistered. If the target device has the authorized public key pair and CSI having a "0" value, authentication is judged to be successful. If the target device does not hold CSI having a "0" value, control unit 101 judges the target device to already be registered in another authorized domain. Moreover, whether or not the authorized domain in which the target device is registered is the authorized domain managed by AD server 100 may be judged by confirming whether the CSI of the target device matches the CSI stored in CSI storage unit 108.

25          When judged that the target device is unregistered, control unit 101 reads registration information from registration-information storage unit 106, and judges whether

the remaining number of devices is "0". If the remaining number is not "0", control unit 101 judges whether the registered number is "0". If the registered number is "0", control unit 101 controls CSI generation unit 107 to generate CSI, and stores the generated  
5 CSI in CSI storage unit 108. If the registered number is not "0", control unit 101 reads CSI from CSI storage unit 108, has the generated or read CSI encrypted by encryption unit 110 to generate encryptedCSI, and outputs the encryptedCSI to playback apparatus 200 via IO unit 115. On receipt from playback apparatus  
10 200 of a receipt notification showing that the outputted CSI has been received, control unit 101 adds "1" to the registered number in the registration information, subtracts "1" from the remaining number, and ends the processing.

If authentication is unsuccessful, or if the target device  
15 is registered, or if the remaining number is "0", control unit 101 transmits a registration failure notification to playback apparatus 200 showing that registration is not possible, and ends the processing.

Also, at a time of CSI being generated by CSI generation  
20 unit 107, control unit 101 establishes a SAC with IC card 400 and shares session key *SK*, performs encryption algorithm *E* on the generated CSI using session key *SK* to generate encrypted CSI, and transmits the encrypted CSI to IC card 400.

#### Registration of On-vehicle 300

25 (a) On receipt of an input from input unit 113 showing the copying of CSI when IC card 400, whose ID has already been confirmed, is connected, control unit 101 judges whether the

remaining number is "0", and if not "0", transmits a permission right to IC card 400 showing that a once-only copy of CSI is permitted. Control unit 101, on receipt from IC card 400 of a receipt notification, ends the processing.

5        When the remaining number is "0", control unit 101 displays the fact that copying is not possible on display unit 114, and ends the processing.

(b) When IC card 400 is connected to AD server 100, AD server 100 confirms that the IC card ID has been registered  
10      in the registration information, and on receipt of a copy notification showing that CSI has been copied, control unit 101 extracts the ID of the CSI copy target (i.e. on-vehicle device 300), which is included in the copy notification, and stores the extracted ID as a device ID in the registration  
15      information. Also, control unit 101 transmits a receipt notification to IC card 400 showing that the copy target ID has been received.

Moreover, although the above description relates here to CSI having been generated, when CSI has not been generated,  
20      CSI is generated and transmitted to IC card 400 in the same manner as when playback apparatus 200 is registered.

#### Content Delivery

On receipt of a content delivery request from playback apparatus 200 via IO unit 115, control unit controls  
25      public-key-encryption processing unit 105 to establish a SAC using the SAC establishment method to be described later, and shares session key SK. Since CSI stored in CSI storage unit

108 is used in authentication conducted at the time of establishing the SAC, when authentication is successful, control unit 101 judges that the target device is registered because of the target device holding CSI generated in AD server 100, and when authentication is unsuccessful, control unit 101 judges that the target device is not registered in AD server 100.

When authentication is unsuccessful, control unit 101 transmits a delivery failure notification to playback apparatus 200 showing that distribution of contents is not possible.

When authentication is successful, control unit 101 controls decryption unit 117 to decrypt encrypted content key  $a$  stored in content-key storage unit 118 to obtain a content key. Next, control unit 101 controls encryption unit 110 to encrypt the content key using session key  $SK$  to generate an encrypted content key  $s$ , and transmits encrypted content key  $s$  to playback apparatus 200. Also, control unit 101 reads an encrypted content from content storage unit 109, and transmits the encrypted content to playback apparatus 200.

#### 20 Recording of a Content onto DVD

On receipt of an input from input unit 113 indicating to record a content onto DVD 500, control unit 101 controls decryption unit 117 to decrypt encrypted content key  $a$  stored in content-key storage unit 118 to obtain a content key. Next, control unit 101 controls encryption unit 110 to encrypt the content key using encryption key  $b$  and encryption key  $c$  generated respectively using  $ID\_2$  and  $ID\_3$  registered in the registration

information to generate encrypted content key *b* and encrypted content key *c*, and writes the encrypted content keys *b* and *c* to DVD 500. Also, control unit 101 reads an encrypted content from content storage unit 109 and writes the encrypted content 5 to DVD 500.

Moreover, the content key may be encrypted using an encryption key generated based on an ID unique to DVD 500, or an encryption key generated based on the DVD 500 ID and CSI.

#### Withdrawal

On receipt from playback apparatus 200 of a withdrawal request that includes *ID\_2*, control unit 101 controls public-key-encryption processing unit 105 to establish a SAC using the SAC establishment method to be described later. At this time, control unit 101 conducts authentication using CSI stored in CSI storage unit 108. From the authentication result at the time of establishing the SAC, control unit 101 judges whether the device that sent the request is registered, and if the target device is unregistered, control unit 101 transmits an unregistered notification to playback apparatus 200 showing 15 playback apparatus 200 to be unregistered, since it is impossible to withdraw in this case.

When playback apparatus 200 is registered, control unit 101 transmits a deletion notification to playback apparatus 200 indicating to delete CSI. On receipt of a deletion-completed 20 notification from playback apparatus 200 showing that deletion of the CSI has been completed, control unit 101 deletes *ID\_2* from DEVICE ID in the registration information, subtracts "1"

from the registered number, and adds "1" to the remaining number.

## 1.2 Structure of Playback apparatus 200

As shown in Fig. 4, playback apparatus 200 is structured from a control unit 201, a secret-key storage unit 202, a public-key-certificate storage unit 203, a CRL storage unit 204, a public-key-encryption processing unit 205, a CSI storage unit 208, a content storage unit 209, an ID storage unit 211, an input unit 213, an input/output (IO) unit 215, a decryption unit 217, an encryption unit 218, a content-key storage unit 219, a decryption unit 220, and a playback unit 221. A monitor 251 and a speaker 252 are connected to playback unit 221.

Playback apparatus 200 is a computer system the same AD server 100, and a computer program is stored in the RAM or the hard disk unit. Playback apparatus 200 carries out functions as a result of the microprocessor operating in accordance with the computer program.

### (1) IO Unit 215

IO unit 215 conducts transmission/reception of data with AD server 100.

(2) Secret-Key Storage Unit 202, Public-Key-Certificate Storage Unit 203, CRL Storage Unit 204, CSI Storage Unit 208, ID Storage Unit 211

CRL storage unit 204 stores the most recent CRL.

ID storage unit 211 stores *ID\_2*, which is the ID unique

to playback apparatus 200.

CSI storage unit 208 is a tamper-resistant area, and stores "0" showing playback apparatus 200 to be unregistered. When playback apparatus 200 is registered in AD server 100, CSI 5 storage unit 208 stores CSI acquired from AD server 100.

Public-key-certificate storage unit 203 stores a PKC Cert\_2 issued by the CA. PKC Cert\_2 includes a public key  $PK_2$  of playback apparatus 200,  $ID_2$  of playback apparatus 200, and signature data  $Sig_{CA2}$  generated by the CA performing signature 10 algorithm  $S$  on public key  $PK_2$  and  $ID_2$ .

Secret-key storage unit 202 is a tamper-resistant area, and stores a secret key  $SK_2$  corresponding to public key  $PK_2$  of playback apparatus 200.

15 (3) Public-Key-Encryption Processing Unit 205

Public-key-encryption processing unit 205 establishes a SAC by the SAC establishment method to be described later, at a time of communicating with AD server 100, and shares session key  $SK$ . Unit 205 outputs the shared session key  $SK$  to decryption 20 unit 217.

(4) Decryption Unit 217, Decryption Unit 220

Decryption unit 217, at a time of a content being distributed from AD server 100, performs decryption algorithm 25  $D$  on encrypted content key  $s$  delivered from AD server 100, using session key  $SK$  shared by public-key-encryption processing unit 205, to obtain a content key. Here, decryption algorithm  $D$  is

an algorithm for conducting the reverse processing of encryption algorithm  $E$ .

Also, at a time of playing a content once stored, decryption unit 217 reads  $ID\_2$  from ID storage unit 211, reads CSI from 5 CSI storage unit 208, and concatenates the reads  $ID\_2$  and CSI in the stated order to generate a decryption key  $b$ . Decryption unit 217 performs decryption algorithm  $D$  on encrypted content key  $b$  read from content-key storage unit 219, using the generated decryption key  $b$ , to obtain a content key, and outputs the 10 obtained content key to decryption unit 220.

Decryption unit 220 reads an encrypted content stored in content storage unit 209, performs decryption algorithm  $D$  on the encrypted content using the content key received from decryption unit 217 to obtain a content, and outputs the obtained 15 content to playback unit 221.

#### (5) Encryption Unit 218

Encryption unit 218, at a time of storing a content acquired from AD server 100, reads  $ID\_2$  from ID storage unit 211, and 20 reads CSI from CSI storage unit 208. Unit 218 concatenates the read  $ID\_2$  and CSI in the stated order to generate encryption key  $b$ , and performs encryption algorithm  $E$  on the content key received from decryption unit 217 using the generated encryption 25 key  $b$  to generate encrypted content key  $b$ , and outputs encrypted content key  $b$  to content-key storage unit 219.

#### (6) Content Storage Unit 209, Content-Key Storage Unit 219

Content storage unit 209 stores encrypted contents transmitted from AD server 100.

Content-key storage unit 219 stores encrypted content key *b* encrypted by encryption unit 218.

5

(7) Control Unit 201, Input Unit 213

Registration

On receipt by input unit 213 of an input indicating to start the registration processing, control unit 201 reads *ID\_2* from ID storage unit 211, transmits a registration request that includes *ID\_2* to AD server 100 via IO unit 215, and establishes a SAC by the SAC establishment method to be described later.

Control unit 201, on receipt from AD server 100 of a registration failure notification, displays the fact that registration is not possible on monitor 251, and ends the registration processing.

Control unit 201, on receipt from AD server 100 of encrypted CSI, controls decryption unit 217 to decrypt the encrypted CSI to obtain CSI, and stores the obtained CSI in CSI storage unit 208. Also, unit 201 transmits a receipt notification to AD server 100 showing that the CSI has been received.

Content Delivery

On receipt by input unit 213 of an input indicating to acquire and playback a content, control unit 201 transmits a delivery request to AD server 100.

Control unit 201, on receipt of a delivery failure notification from AD server 100, displays the fact that delivery

is not possible on monitor 251, and ends the processing.

When a received content is to be played, control unit 201, on receipt of encrypted content key  $s$  from AD server 100, controls decryption unit 217 to decrypt encrypted content key 5  $s$  to obtain a content key. Also, on receipt of an encrypted content from AD server 100, control unit 201 controls decryption unit 220 to decrypt the encrypted content to obtain a content, and has playback unit 221 play the content.

#### Playback after Accumulating Contents

10 On receipt by input unit 213 of an input indicating to acquire and accumulate contents, control unit 201 conducts the same processing as above to acquire contents. Once contents have been acquired, control unit 201 has decryption unit 217 decrypt encrypted content key  $s$  received from AD server 100, 15 and controls encryption unit 218 to encrypt the decrypted content key, and stores the encrypted content key in content-key storage unit 219 as encrypted content key  $b$ . Also, on receipt of encrypted contents from AD server 100, control unit 201 stores the encrypted contents in content storage unit 209.

20 On receipt by input unit 213 of an input indicating to playback contents stored in content storage unit 209, control unit 201 controls decryption unit 217 to decrypt encrypted content key  $b$ , has decryption unit 220 decrypt the encrypted contents to obtain contents, and has playback unit 221 play 25 the contents.

#### Withdrawal

On receipt by input unit 213 of an input indicating to

start withdrawal processing, control unit 201 establishes a SAC by the SAC establishment method to be described later.

Control unit 201, on receipt of an unregistered notification from AD server 100, displays on monitor 251 the 5 fact that playback apparatus 200 is not registered in AD server 100, and ends the processing.

Control unit 201, on receipt of a deletion notification from AD server 100, deletes CSI stored in CSI storage unit 208, and stores "0" in CSI storage unit 208 showing playback apparatus 10 200 to be unregistered. Also, control unit 201 transmits a deletion-completed notification that notifies AD server 100 that deletion of the CSI has been completed.

#### (8) Playback Unit 221

15 Playback unit 221 generates video signals from contents received from decryption unit 220, and outputs the generated video signals to monitor 251. Also, unit 221 generates audio signals from received contents, and outputs the generated audio signals to speaker 252.

20

#### 1.4 Structure of On-Vehicle Device 300

As shown in Fig. 5, on-vehicle device 300 is structured from a control unit 301, a secret-key storage unit 302, a public-key-certificate storage unit 303, a CRL storage unit 25 304, a public-key-encryption processing unit 305, a CSI storage unit 308, an ID storage unit 311, a drive unit 312, an input unit 313, an input/output (IO) unit 316, decryption units 317,

318 and 320, a playback unit 321, a monitor 322 and a speaker 323.

On-vehicle device 300 is a computer system the same AD server 100, and a computer program is stored on the RAM or the 5 hard disk unit. On-vehicle device 300 carries out functions as a result of the microprocessor operating in accordance with the computer program.

(1) Drive Unit 312, IO Unit 316

10 Drive Unit 312 reads encrypted content key  $c$  from DVD 500, and outputs encrypted content key  $c$  to decryption unit 318. Also, unit 312 reads an encrypted content and outputs the encrypted content to decryption unit 320.

15 IO unit 316 conducts transmission/reception of data with IC card 400, under the control of control unit 301.

(2) Secret-Key Storage Unit 302, Public-Key-Certificate Storage Unit 303, CRL Storage Unit 304, CSI Storage Unit 308, ID Storage Unit 311

20 CRL storage unit 304 stores the most recent CRL.

ID storage unit 311 stores  $ID_3$ , which is the ID unique to on-vehicle device 300.

CSI storage unit 308 is a tamper-resistant area, and stores "0" showing on-vehicle device 300 to be unregistered. On receipt 25 from IC card 400 of CSI generated by AD server 100, unit 308 stores the received CSI.

Public-key-certificate storage unit 303 stores a PKC

*Cert\_3* issued by the CA. PKC *Cert\_3* includes a public key *PK\_3* and *ID\_3* of on-vehicle device 300, and signature data *Sig\_CA3* generated by the CA performing signature algorithm *S* on public key *PK\_3* and *ID\_3*.

5           Secret-key storage unit 302 is a tamper-resistant area, and stores a secret key *SK\_3* corresponding to public key *PK\_3*.

(3) Public-Key-Encryption Processing Unit 305

Public-key-encryption processing unit 305 conducts  
10 authentication with IC card 400, under the control of control unit 301, and establishes a SAC by the SAC establishment method to be described later. Also, unit 305 outputs session key *SK* shared at this time to decryption unit 317.

15       (4) Decryption Units 317, 318, 320

Decryption unit 317, on receipt of encrypted CSI from IC card 400 and under the control of control unit 301, performs decryption algorithm *D* on the encrypted CSI using session key *SK* received from public-key-encryption processing unit 305 to  
20 obtain CSI, and outputs the obtained CSI to CSI storage unit 308.

At a time of playing a content, decryption unit 318, on receipt of encrypted content key *c* from drive unit 312, reads *ID\_3* from ID storage unit 311 and reads CSI from CSI storage  
25 unit 308. Unit 318 concatenates the read *ID\_3* and CSI in the stated order to generate decryption key *c*. Unit 318 performs decryption algorithm *D* on encrypted content key *c* using

decryption key  $c$  to obtain a content key, and outputs the obtained content key to decryption unit 320.

Decryption unit 320 receives an encrypted content from drive unit 312 and a content key from decryption unit 318. Unit 5 320 performs decryption algorithm  $D$  on the encrypted content using the received content key to obtain a content, and outputs the obtained content to playback unit 321.

(5) Control Unit 301, Input Unit 313

10 Control unit 301, when IC card 400 is connected to on-vehicle device 300, controls public-key-encryption processing unit 305 to establish a SAC. At this time, unit 301 uses the "0" stored in CSI storage unit 308 as CSI. If device authentication is unsuccessful, unit 301 ends the processing.  
15 Also, when a registered notification is received from IC card 400, unit 301 displays the fact that on-vehicle device 300 is registered on monitor 322, and ends the processing. Unit 301, on receipt of encrypted CSI from IC card 400 via IO unit 316, controls decryption unit 317 to decrypt the encrypted CSI to  
20 obtain CSI, and stores the obtained CSI in CSI storage unit 308. Also, unit 301 transmits a receipt notification to IC card 400 showing that the CSI has been received.

Moreover, copying of CSI from on-vehicle device 300 to other devices is not conducted.

25 Control unit 301, on receipt of an input from input unit 313 indicating to view a content recorded on DVD 500, controls drive unit 312 to read encrypted content key  $c$  and an encrypted

content from DVD 500. Unit 301 has encrypted content key c decrypted by decryption unit 318 to obtain a content key, and has the encrypted content decrypted by decryption unit 320 to obtain a content. Also, unit 301 controls playback unit 321  
5 to play the obtained content.

(6) Playback Unit 321, Monitor 322, Speaker 323

Playback unit 321 generates video signals and audio signals from received contents, outputs the generated video  
10 and audio signals to monitor 322 and speaker 323 respectively, and plays the contents.

### 1.3 Structure of IC Card 400

As shown in Fig. 6, IC card 400 is structured from a control  
15 unit 401, a secret-key storage unit 402, a public-key-certificate storage unit 403, a CRL storage unit 404, a public-key-encryption processing unit 405, a CSI storage unit 408, an ID storage unit 411, an input/output (IO) unit 416, a decryption unit 417, an encryption unit 418, and an ID  
20 storage unit 420.

IC card 400 is connectable to AD server 100 and on-vehicle device 300. IC card 400 is used as a device within the authorized domain at a time of registering devices such as on-vehicle device 300 that are not connectable with AD server 100.

25

(1) Secret-Key Storage Unit 402, Public-Key-Certificate Storage Unit 403, CRL Storage Unit 404, CSI Storage Unit 408,

ID Storage Unit 411, ID Storage Unit 420

CRL storage unit 404 stores the most recent CRL.

ID storage unit 411 stores an *ID\_4*, which is an ID unique to IC card 400.

5 CSI storage unit 408 is a tamper-resistant area, and when a client device has not been registered in AD server 100, stores "0" showing that a client device has yet to be registered. When CSI is generated by AD server 100, unit 408 stores CSI obtained from AD server 100 in correspondence with "0", which is the  
10 copy frequency. Here, the copy frequency is the number of times that copying of CSI to other client devices is permitted.

Public-key-certificate storage unit 403 stores a PKC *Cert\_4* issued by the CA. PKC *Cert\_4* includes a public key *PK\_4* and *ID\_4* of IC card 400, and signature data *Sig\_C4* generated  
15 by the CA performing signature algorithm *S* on public key *PK\_4* and *ID\_4*.

Secret-key storage unit 402 is a tamper-resistant area, and stores a secret key *SK\_4* corresponding to public key *PK\_4*.

20 ID storage unit 420 is an area storing the ID of a CSI copy target.

## (2) Public-Key-Encryption Processing Unit 405

Public-key-encryption processing unit 405, under the control of control unit 401, establishes a SAC with AD server  
25 100, shares session key *SK*, and outputs the shared session key *SK* to decryption unit 417.

Also, unit 405 establishes a SAC with on-vehicle device

300 and shares session key  $SK$ , and outputs the shared session key  $SK$  to encryption unit 418.

(3) Decryption Unit 417

5       Decryption unit 417, on receipt of encrypted CSI via IO unit 416 and under the control of control unit 401, performs decryption algorithm  $D$  on the encrypted CSI using session key  $SK$  received from public-key-encryption processing unit 405 to obtain CSI, and stores the obtained CSI in CSI storage unit  
10      408.

(4) Encryption Unit 418

Encryption unit 418, under the control of control unit 401, reads CSI from CSI storage unit 408, receives session key  
15       $SK$  from public-key-encryption processing unit 405, performs encryption algorithm  $E$  on the CSI using session key  $SK$  to generate encrypted CSI, and transmits the encrypted CSI to on-vehicle device 300.

20      (5) Control Unit 401, IO Unit 416

When IC card 400 is connected to AD server 100, control unit 401 reads  $ID\_4$  from ID storage unit 411, and transmits the read  $ID\_4$  to AD server 100.

At a time of receiving CSI from AD server 100, control  
25      unit 401 controls public-key-encryption processing unit 405 to establish a SAC with AD server 100 and share session key  $SK$ , and on receipt of encrypted CSI, unit 401 has the encrypted

CSI decrypted by decryption unit 417 to obtain CSI, and stores the obtained CSI in CSI storage unit 408.

At a time of registering on-vehicle device 300, control unit 401, on receipt of a permission right from AD server 100, 5 adds "1" to the copy frequency stored in correspondence with the CSI, and transmits a receipt notification to AD server 100.

When IC card 400 is connected to on-vehicle device 300, control unit 401 controls public-key-encryption processing unit 405 to establish a SAC, and shares session key *SK*. At this 10 time, unit 401 conducts authentication using the initial value "0" as CSI, and from the authentication result, judges whether on-vehicle device 300 is unregistered. If authentication is unsuccessful, unit 401 judges on-vehicle device 300 to be registered, transmits a registered notification to on-vehicle 15 device 300, and ends the processing. When authentication is successful, unit 401 judges on-vehicle device 300 to be unregistered, and stores *ID\_3* of on-vehicle device 300 received at the time of authentication in ID storage unit 420. Unit 401 reads CSI stored in CSI storage unit 408, has the read CSI 20 encrypted by encryption unit 418 to generate encrypted CSI, and transmits the encrypted CSI to on-vehicle device 300. Unit 401, on receipt of a receipt notification from on-vehicle device 300, subtracts "1" from the copy frequency and ends the processing. Control unit 401, when IC unit 400 is connected 25 to AD server 100, reads *ID\_4* from ID storage unit 411, and transmits the read *ID\_4* to AD server 100. Also, unit 401 reads the ID of the CSI copy target from ID storage unit 420, and

sends a copy notification that includes the read ID to AD server 100. On receipt from AD server 100 of a receipt notification, unit 401 ends the processing.

5 <Operations of Group Formation/Management System 1>

2.1 SAC Operations

Operations at a time of establishing a SAC will be described using Figs. 7 and 8.

Moreover, since this SAC establishment method is used  
10 in the mutual authentication of any of AD server 100, playback apparatus 200, on-vehicle device 300, and IC card 400, the devices conducting authentication here are referred to simply as device A and device B. Also, although CSI used in authentication can be "0" showing unregistered or values  
15 generated by AD server 100, here it is described simply as "CSI".

Here,  $\text{Gen}()$  is a key generation function and  $Y$  is a system-unique parameter. Also, key generation function  $\text{Gen}()$  is a function that satisfies a relation  $\text{Gen}(x, \text{Gen}(Y, z)) = \text{Gen}(Y, \text{Gen}(x, z))$ . Moreover, since key generation functions are  
20 realizable by arbitrary known technology, the details of such functions will not be referred to here. As one example, a Diffie-Hellman (DH) public key delivery method is disclosed in Nobuichi IKENO, Kenji KOYAMA, *Modern Cryptosystems*, IEICE.

Device A reads PKC Cert\_A (step S11), and transmits the  
25 read PKC Cert\_A to device B (step S12).

Device B, having receiving PKC Cert\_A, conducts signature verification by performing a signature verification algorithm

V on signature data *Sig\_CA* included in the PKC *Cert\_A*, using a public key *PK\_CA* of the CA (step S13). If verification is unsuccessful (step S14 = NO), device B ends the processing. If verification is successful (step S14 = YES), device B reads 5 a CRL (step S15), and judges whether *ID\_A* included in the received PKC *Cert\_A* is registered in the CRL (step S16). If judged to be registered (step S16 = YES), device B ends the processing. If judged to be not registered (step S16 = NO), device B reads PKC *Cert\_B* of device B (step S17), and transmits the read PKC 10 *Cert\_B* to device A (step S18).

Device A, on receipt of PKC *Cert\_B*, conducts signature verification by performing signature verification algorithm V on signature data *Sig\_CA* included in the PKC *Cert\_B*, using public key *PK\_CA* (step S19). If verification is unsuccessful 15 (step S20 = NO), device A ends the processing. If verification is successful (step S20 = YES), device A reads a CRL (step S21), and judges whether *ID\_B* included in the received PKC *Cert\_B* is registered in the CRL (step S22). If judged to be registered (step S22 = YES), device A ends the processing. If judged to 20 be not registered (step S22 = NO), device A continues the processing.

Device B generates a random number *Cha\_B* (step S23), and transmits generated random number *Cha\_B* to device A (step S24).

Device A, on receipt of random number *Cha\_B*, concatenates 25 *Cha\_B* and *CSI* in the stated order to generate *Cha\_B* || *CSI* (step S25), performs signature algorithm *S* on the generated *Cha\_B* || *CSI* using a secret key *SK\_A* of device A to generate signature

data  $Sig_A$  (step S26), and transmits the generated signature data  $Sig_A$  to device B (step S27).

Device B, on receipt of signature data  $Sig_A$ , conducts signature verification by performing signature verification 5 algorithm  $V$  on the received signature data  $Sig_A$  using  $PK_A$  included in  $Cert_A$  received at step S12 (step S28), and if verification is unsuccessful (step S29 = NO), device B ends the processing, and if successful (step S29 = YES), device B continues the processing.

10 Device A generates a random number  $Cha_A$  (step S30), and transmits generated random number  $Cha_A$  to device B (step S31).

Device B, concatenates the received  $Cha_A$  and CSI in the stated order to generate  $Cha_A \parallel CSI$  (step S32), performs signature algorithm  $S$  on the generated  $Cha_A \parallel CSI$  using a secret 15 key  $SK_B$  of device B to generate signature data  $Sig_B$  (step S33), and transmits the generated signature data  $Sig_B$  to device A (step S34).

Device A, on receipt of signature data  $Sig_B$ , conducts signature verification by performing signature verification 20 algorithm  $V$  on signature data  $Sig_B$  using  $PK_B$  included in  $Cert_B$  received at step S18 (step S35), and if verification is unsuccessful (step S36 = NO), device A ends the processing. If successful (step S36 = YES), device A generates a random number "a" (step S37), generates  $Key_A = Gen(a, Y)$  using generated 25 random number "a" (step S38), and transmits the generated  $Key_A$  to device B (step S39).

Device B, on receipt of  $Key_A$ , generates a random number

"*b*" (step S40), and generates  $Key_B = Gen(b, Y)$  using generated random number "*b*" (step S41). Device B transmits the generated  $Key_B$  to device A (step S42). Also, device B generates  $Key_{AB} = Gen(b, Key_A) = Gen(b, Gen(a, Y))$  using generated random number "b" and the received  $Key_A$  (step S43), and generates session key  $SK = Gen(CSI, Key_{AB})$  using  $Key_{AB}$  and the CSI (step S44).

Device A, on receipt of  $Key_B$ , generates  $Key_{AB} = Gen(a, Key_B) = Gen(a, Gen(b, Y))$  using generated random number "a" and the received  $Key_B$  (step S45), and generates session key  $SK = Gen(CSI, Key_{AB})$  using the generated  $Key_{AB}$  and the CSI (step S46).

## 2.2 Operations for Playback Apparatus 200 Registration

Operations at a time of AD server 100 registering playback apparatus 200 will now be described using Fig. 9.

Moreover, AD server 100 has IC card 400 connected thereto, and has already confirmed that IC card 400 is an IC card affiliated with AD server 100.

Playback apparatus 200, on receipt of an input from input unit 213 indicating to start the registration processing (step S51), reads  $ID_2$  from ID storage unit 211 (step S52), and transmits a registration request that includes  $ID_2$  to AD server 100 (step S53).

Given that AD server 100 is device A and playback apparatus 200 is device B, a SAC is established by the above-described method (step S54). At this time, AD server 100 uses "0" as CSI and playback apparatus 200 uses CSI stored in CSI storage unit

208.

AD server 100 conducts the signature verification at step S35 using "0" as CSI, and thus judges playback apparatus 200 to be unregistered if verification is successful, and to be registered if verification is unsuccessful. If playback apparatus 200 is judged to be unregistered, AD server 100 reads registration information (step S55), and judges whether the remaining number is "0" (step S56). If "0" (step S56 = YES), AD server 100 transmits a registration failure notification to playback apparatus 200 (step S57). If the remaining number is not "0" (step S56 = NO), AD server 100 judges whether the registered number is "0" (step S58). If "0" (step S58 = YES), CSI is generated by CSI generation unit 107 (step S59). If the registered number is not "0" (step S58 = NO), AD server 100 reads CSI from CSI storage unit 108 (step S60). Encryption algorithm E is performed on the generated or read CSI by encryption unit 119 using session key SK, to generate encrypted CSI (step S61), and AD server 100 transmits the encrypted CSI to playback apparatus 200 (step S62).

20 Playback apparatus 200, if a registration failure notification is received, displays the fact that registration is not possible on monitor 251 (step S63), and ends the processing. If encrypted CSI is received, the encrypted CSI is decrypted by decryption unit 217 to obtain CSI (step S64), and playback apparatus 200 stores the CSI in CSI storage unit 208 (step S65). Also, playback apparatus 200 transmits a receipt notification to AD server 100 (step S66).

On receipt of the receipt notification from playback apparatus 200, AD server 100 writes *ID\_2* into DEVICE ID in the registration information, adds "1" to the registered number, and subtracts "1" from the remaining number (step S67).

5

### 2.3 Operations for On-vehicle Device 300 Registration

(1) Operations at a time of permitting the copying of CSI from AD server 100 to IC card 400 will now be described using Fig. 10.

10 When IC card 400 is connected to AD server 100, IC card 400 reads *ID\_4* from ID storage unit 411 (step S71), and transmits the read *ID\_4* to AD server 100 (step S72).

AD server 100, on receipt of *ID\_4*, reads an IC card ID from the registration information (step S73), and judges whether 15 the received ID matches the read ID (step S74). If not matched (step S74 = NO), AD server 100 displays on display unit 114 the fact that the connected IC card is not an IC card affiliated with AD server 100 (step S75) and ends the processing. If matched (step S74 = YES), AD server 100 continues the processing. In 20 this way, AD server 100 confirms whether the connected IC card is an affiliated IC card, and stands by until an input is received once confirmation is completed.

On receipt by input unit 113 of an input indicating to permit a copying of CSI to IC card 400 (step S76), control unit 25 101 reads the remaining number from registration-information storage unit 106 (step S77), judges whether the remaining number is "0" (step S78), and if "0" (step S78 = YES), displays on

display unit 114 the fact that registration is not possible (step S79). If the remaining number is not "0" (step S78 = NO), control unit 101 transmits a permission right to IC card 400 permitting a once-only copying of CSI (step S80).

5       IC card 400, on receipt of the permission right from AD server 100, adds "1" to the copy frequency (step S81), and transmits a receipt notification to AD server 100 (step S82).

AD server 100, on receipt of the receipt notification, adds "1" to the registered number in the registration information, 10 subtracts "1" from the remaining number (step S83), and ends the processing.

(2) Operations at a time of copying CSI from IC card 400 to on-vehicle 300 will now be described using Fig. 11.

15       When IC card 400 is connected to on-vehicle device 300, the steps S71 to S75 processing is conducted, and IC card 400 is ascertained. Also, IC card 400 and on-vehicle device 300 conducts SAC establishment processing as device A and device B, respectively, and share session key SK (step S91). At this 20 time, IC card 400 conducts authentication using "0", which is the initial value of CSI, and on-vehicle device 300 conducts authentication using a value stored in CSI storage unit 308.

Control unit 401 in IC card 400 conducts the signature verification at step S35 using "0" as CSI, and thus judges 25 on-vehicle device 300 to be unregistered if verification is successful, and to be registered if verification is unsuccessful. If judged to be registered (step S92 = NO), IC card 400 transmits

a registration failure notification to on-vehicle device 300 (step S93), and ends the processing. If judged to be unregistered (step S92 = YES), IC card 400 stores *ID\_3* of on-vehicle device 300 received at step S18 in ID storage unit 420 (step S94).

5      Encryption unit 418, on receipt of session key *SK* from public-key-encryption processing unit 405, reads CSI from CSI storage unit 408 (step S95). Encryption unit 418 encrypts the CSI using session key *SK* to generate encrypted CSI (step S96), and transmits the encrypted CSI to on-vehicle device 300 via

10     IO unit 416 (step S97).

Control unit 301 in on-vehicle device 300, if a registration failure notification is received from IC card 400, displays the fact that registration is not possible on monitor 322 (step S98), and ends the processing. If encrypted CSI is received from IC card 400, decryption unit 317 receives session key *SK* from public-key-encryption processing unit 305, and decrypts the encrypted CSI using session key *SK* to obtain CSI (step S99), and stores the obtained CSI in CSI storage unit 308 (step S100). Also, control unit 301 transmits a receipt notification to IC card 400 (step S101).

IC card 400, on receipt of the receipt notification from on-vehicle device 300, subtracts "1" from the copy frequency (step S102) and ends the processing.

25     (3)    Operations at a time of notifying AD server 100 of the copying of CSI will now be described.

When IC card 400 is connected to AD server 100, AD server

100 confirms the ID of IC card 400 to confirm that IC card 400 is an affiliated IC card, and stands by until an input is received once confirmation is completed.

IC card 400 reads *ID\_3*, which is the ID of the copy target,  
5 from ID storage unit 420, and transmits a copy notification that includes *ID\_3* to AD server 100.

AD server 100, on receipt of the copy notification, stores  
*ID\_3* included in the copy notification in the registration information as a device ID. Also, AD server 100 transmits a  
10 receipt notification to IC card 400 and ends the processing.

IC card 400, on receipt of the receipt notification from AD server 100, ends the processing.

#### 2.4 Content Delivery Operation 1

15 Operations at a time of delivering a content from AD server 100 to playback apparatus 200 and playing the delivered content will now be described using Fig. 12.

Playback apparatus 200, on receipt of an input indicating to acquire a content from input unit 213 (step S121), transmits  
20 a delivery request for a content to AD server 100 (step S122).

AD server 100 and playback apparatus 200 establish a SAC (step S123). At this time, server 100 and device 200 conduct authentication using CSI stored in respective CSI storage units.

AD server 100 confirms that playback apparatus 200 is  
25 within the same authorized domain by the processing at step S35.

If authentication is unsuccessful (step S124 = NO), AD

server 100 transmits a delivery failure notification to playback apparatus 200 (step S125) and ends the processing. If authentication is successful (step S124 = YES), AD server 100 reads encrypted content key  $a$  from content-key storage unit 118 (step S126), encrypted content key  $a$  is decrypted by decryption unit 117 (step S127), and furthermore, the content key is encrypted in encryption unit 110 using session key  $SK$  shared at a time of authentication, to generate encrypted content key  $s$  (step S128), and AD server 100 transmits encrypted content key  $s$  to playback apparatus 200 (step S129). Also, AD server 100 reads an encrypted content from content storage unit 109 (step S130), and transmits the encrypted content to playback apparatus 200 (step S131).

Playback apparatus 200, in the case of a delivery failure notification being received, displays the fact that delivery is not possible on monitor 251 (step S132) and ends the processing. In the case of encrypted content key  $s$  being received, encrypted content key  $s$  is decrypted in decryption unit 217 using session key  $SK$  to obtain a content key (step S133), and the obtained content key is outputted to decryption unit 220. Decryption unit 220 performs decryption algorithm  $D$  on the encrypted content received from AD server 100, using the content key received from decryption unit 217, to obtain a content (step S134), and outputs the obtained content to playback unit 221. Playback unit 221 generates video and audio signals from the received content and outputs the generated video and audio signals respectively to monitor 251 and speaker 252, and plays the

content (step S135).

## 2.5 Content Delivery Operation 2

Operations at a time of playing contents received from  
5 AD server 100 once they have been accumulated will now be  
described using Fig. 13.

The same processing as in steps S121 to S130 is conducted.

Decryption unit 217 decrypts encrypted content key *s* to  
obtain a content key (step S141), and outputs the obtained  
10 content key to encryption unit 218. Encryption unit 218 reads  
CSI from CSI storage unit 208 and *ID\_2* from ID storage unit  
211 (step S142). Encryption unit 218 concatenates the read *ID\_2*  
and CSI in the stated order to generate *ID\_2*||CSI (step S143),  
and sets *ID\_2*||CSI as encryption key *b*. Encryption unit 218  
15 encrypts the content key using the generated encryption key  
*b* to generate encrypted content key *b* (step S144), and stores  
encrypted content key *b* in content-key storage unit 219 (step  
S145). Also, on receipt of an encrypted content from AD server  
100, control unit 201 stores the received encrypted content  
20 in content storage unit 209 (step S146).

On receipt from input unit 213 of an input indicating  
to play a stored content, decryption unit 217 reads encrypted  
content key *b* from content-key storage unit 219 (step S148).  
Also, decryption unit 217 reads CSI from CSI storage unit 208  
25 and *ID\_2* from ID storage unit 211 (step 149), concatenates the  
read *ID\_2* and CSI to generate *ID\_2*||CSI (step S150), and sets  
*ID\_2*||CSI as a decryption key. Decryption unit 217 performs

decryption algorithm  $D$  on encrypted content key  $b$  using the generated decryption key to obtain a content key (step S151), and outputs the obtained content key to decryption unit 220. Decryption unit 220 and playback unit 221 conduct the steps  
5 S133 to S135 processing to play the content.

## 2.6 Operations at a time of Recording onto DVD

Operation at a time of a content being written to DVD 500 by AD server 100 will now be described using Fig. 14.

10 AD server 100, on receipt from input unit 113 of an input instructing to record a content onto a DVD (step S161), reads encrypted content key  $a$  from content-key storage unit 118 (step S162), and reads  $ID_1$  from ID storage unit 111 and CSI from CSI storage unit 108 (step S163). Decryption unit 117 concatenates the read  $ID_1$  and CSI to generate a decryption key (step S164), and decrypts encrypted content key  $a$  using the generated decryption key to obtain a content key (step S165), and outputs the obtained content key to encryption unit 110.  
15 Encryption unit 110, on receipt of the content key, reads the device IDs from registration-information storage unit 106 and CSI from CSI storage unit 108 (step S166). Encryption unit 110 concatenates the read  $ID_2$  and CSI to generate encryption key  $b$  and concatenates the read  $ID_3$  and CSI to generate encryption key  $c$  (step S167). Encryption unit 110 encrypts the content key respectively using generated encryption keys  $b$  and  $c$  to generate encrypted content keys  $b$  and  $c$  (step S168). Control unit 101 writes encrypted content keys  $b$  and  $c$  to DVD 500 (step  
20  
25

S169). Also, control unit 101 reads an encrypted content from content storage unit 109 (step S170), and writes the encrypted content to DVD 500 (step S171).

5    2.7 Operations for Playback Apparatus 200 Withdrawal

Operations at a time of playback apparatus 200 withdrawing from AD server 100 will now be described using Fig. 15.

Moreover, AD server 100 has IC card 400 connected thereto, and has already confirmed IC card 400.

10      Playback apparatus 200, on receipt from input unit 213 of an input indicating the withdrawal of playback apparatus 200 (step S181), reads *ID\_2* from ID storage unit 211 (step S182), and transmits a withdrawal request that includes *ID\_2* to AD server 100 (step S183).

15      AD server 100 and playback apparatus 200 conduct authentication and establish a SAC (step S184). At this time, authentication is conducted using CSI stored in respective CSI storage units.

20      AD server 100 judges whether playback apparatus 200 is registered as a device in the authorized domain of AD server 100 by the step S35 processing, and if unregistered (step S185 = NO), transmits an unregistered notification to playback apparatus 200 (step S186). If registered (step S185 = YES), AD server 100 transmits a CSI deletion notification to playback apparatus 200 (step S187).

Playback apparatus 200, on receipt of an unregistered notification, displays the fact that playback apparatus 200

is unregistered on monitor 322 (step S188) and ends the processing. On receipt of a deletion notification, playback apparatus 200 deletes CSI from CSI storage unit 208 (step S189). Also, playback apparatus 200 transmits a deletion-completed 5 notification to AD server 100 (step S190).

AD server 100, on receipt of the deletion-completed notification, deletes *ID\_2* from DEVICE ID in the registration information, subtracts "1" from the registered number, and adds "1" to the remaining number (step S191).

10

<MODIFICATIONS OF GROUP FORMATION/MANAGEMENT SYSTEM 1>

While the present invention has been described above based on the above embodiment directed to the group formation/management system 1, the present invention is of course not limited to this embodiment. Modifications such 15 as those described below are also included in the present invention.

(1) Although in the above embodiment, CSI is copied using 20 IC card 400 at a time of registering a device not connected to AD server 100, CSI may be transferred from client device to client device directly without using IC card 400.

The transfer of CSI from playback apparatus 200 to a playback apparatus 200n, and the registration of playback 25 apparatus 200n as a device within the authorized domain managed by AD server 100 will now be described as an example.

Playback apparatus 200 and playback apparatus 200n are

connected, and playback apparatus 200n is operated to transmit a transfer request to playback apparatus 200. Playback apparatus 200 and playback apparatus 200n establish a SAC and generate session key *SK*. Playback apparatus 200 encrypts CSI with the 5 session key *SK* and transmits the encrypted CSI to playback apparatus 200n. Playback apparatus 200n decrypts the encrypted CSI using the session key, stores the CSI, and stores the ID of playback apparatus 200, which is the transfer source, received at a time of establishing the SAC. Also, playback apparatus 10 200n transmits a receipt notification to playback apparatus 200. Playback apparatus 200, on receipt of the receipt notification, deletes the CSI in CSI storage unit 208 and stores "0" in CSI storage unit 208.

Playback apparatus 200n when connected to AD server 100 and when a SAC is established, notifies AD server 100 of the 15 CSI transfer, transmits the ID of the transfer source and the ID of playback apparatus 200n to AD server 100, and AD server 100 rewrites DEVICE ID in the registration information.

20 (2) Although in the above embodiment, IC card 400 is affiliated with AD server 100, IC card 400 need not be affiliated.

In this case, as with other client devices, IC card 400 establishes a SAC when connected to AD server 100, registers *ID\_4* as a device ID, and acquires CSI.

25 AD server 100, at a time of recording a content key onto DVD 500, encrypts the content key using an encryption key generated by concatenating *ID\_4* of IC card 400 and CSI.

On-vehicle device 300, when DVD 500 is mounted therein and when IC card 400 is connected, establishes a SAC with IC card 400 and shares session key *SK*.

IC card 400 concatenates *ID\_4* and CSI stored in IC card 400 to generate a decryption key, encrypts the decryption key using session key *SK* to generate an encrypted decryption key, and transmits the encrypted decryption key to on-vehicle device 300.

On-vehicle device 300 decrypts the encrypted decryption key using session key *SK* to obtain a decryption key, decrypts the encrypted content key read from DVD 500 using the decryption key to obtain a content key, decrypts an encrypted content using the content key to obtain a content, and plays the content.

Also, the same processing as in (1) above to transfer CSI between client devices may be conducted to transfer CSI from an IC card to on-vehicle device 300. In this case, an IC card not affiliated with AD server 100 may, as with IC card 400 in embodiment 1, be provided with the function of notifying AD server 100 of a transfer. In this case, an IC card that transfers CSI to on-vehicle device 300 prohibits the transfer of CSI without immediately deleting the CSI, and deletes the CSI after notifying AD server 100 of the transfer.

(3) When registering a device not connected to AD server 100 using IC card 400, a permission right or CSI may be transmitted from AD server 100 to IC card 400 via a network.

As one example, when IC card 400 is connected to a client

device such as a PC or the like that is connected to a network and has a communication function, IC card 400 conducts SAC establishment processing and receives a permission right or CSI using the communication function of the PC.

5       The client device having the communication function is not limited to being a PC; and may be a personal digital assistant (PDA), a mobile telephone or the like.

10      (4)     In the above embodiment, contents are either delivered from AD server 100 to a client device or recorded onto a DVD and distributed from AD server 100 to a client device. However, a SAC may be established between client devices and session key *SK* generated, and contents delivered from one client device to another client device.

15

(5)     In the above embodiment, on-vehicle device 300 is registered using IC card 400. However, withdrawal processing may be conducted in the same way using IC card 400.

20      In this case, on-vehicle device 300, which has IC card 400 connected thereto, is operated to transmit a withdrawal request to IC card 400, and IC card 400 establishes a SAC to confirm that on-vehicle device 300 is registered, and transmits a deletion notification to on-vehicle device 300. On-vehicle device 300 deletes the CSI, and transmits a deletion-completed 25 notification to IC card 400. IC card 400, on receipt of the deletion-completed notification, stores the ID of the withdrawn on-vehicle device 300. IC card 400, when connected to AD server

100, notifies AD server 100 that on-vehicle device 300 has withdrawn and of the ID of on-vehicle device 300. AD server 100 deletes the ID of on-vehicle device 300 from DEVICE ID in the registration information, subtracts "1" from the registered  
5 number, and adds "1" to the remaining number.

(6) In the above embodiment, AD server 100 confirms whether a target device is registered or unregistered by a value of CSI stored by the target device, using signature verification  
10 at a time of establishing a SAC. However, AD server 100 may confirm that a target device is registered or unregistered by receiving an ID from the device to be authenticated, and judging whether the received ID is stored in DEVICE ID in the registration information. Also, all of the client devices registered as  
15 devices within the authorized domain of AD server 100 may store the registered IDs, and confirm whether other client devices are registered or unregistered by using the IDs in the same way as described above.

20 (7) In the above embodiment, IC card 400 is used at a time of registering a device that is not connected to AD server 100. However, AD server 100 may display CSI on display unit 114, and a user may manually input the CSI into a client device. In this case, a code to be inputted may be a value obtained  
25 by encrypting CSI, depending on the device, the session, and so forth.

(8) In the above embodiment, at a time of establishing a SAC and encrypting and transmitting CSI, signature data of the device transmitting the encrypted CSI may be appended to the ciphertext.

5 (9) In the above embodiment, registration information and CSI is stored internally in respective devices. However, registration information and CSI may be stored in a removable memory area that cannot be read, written or copied without permission.

10

(10) In the above embodiment, the ID of a device and CSI or a random number and CSI are concatenated for use as an encryption key at a time of encrypting a content, and as a decryption key at a time of decrypting the encrypted content key. However, 15 the present invention is not limited to this, and an operation may be conducted using the ID of a device and CSI or a random number and CSI, and the resulting value used.

20 (11) Although in the above embodiment, a maximum number, a registered number and a remaining number are managed as registration information, the present invention is not limited to this.

The maximum number may be set as the initial value of the remaining number and "1" subtracted from the remaining number 25 every time a device is registered, and a client device may be registered if the remaining number is not "0". Also, the maximum number and the registered number may be managed, and a client

device registered if the registered number is less than the maximum number.

(12) The maximum number, the registered number, and the like  
5 may be managed after dividing the number of devices in the registration information into devices connected online to AD server 100 and devices registered using IC card 400.

(13) Although in the above embodiment, AD server 100 conducts  
10 management based on stored registration information, a separate management authority may be provided and structured as in (a) to (c) below.

(a) The management authority sets the maximum number of registerable devices, appends signature data of the management  
15 authority to the maximum number, and either records the maximum number onto a portable recording medium such as a DVD for distribution or distributes the maximum number via a communication channel. AD server 100 verifies the signature data, and if verification is successful, stores the maximum  
20 number as MAXIMUM in the registration information.

(b) AD server 100 requests the management authority for the number of devices that AD server 100 seeks to register. The management authority conducts accounting in response to the number of devices, and if the accounting is successful,  
25 transmits information to AD server 100 permitting registration of the requested number of devices, and AD server 100, on receipt of the information, accepts the registration of client devices

within the permitted number.

(c) AD server 100 sends out a request to the management authority every time a registration is received from a client device, and the management authority conducts accounting in response to the request, and permits the registration if the accounting is successful. AD server 100, when registration is permitted, registers the client device and transmits CSI to the client device.

10 (14) In the above embodiment, playback apparatus 200 plays contents delivered from AD server 100. However, playback apparatus 200 may have a DVD playback function, and play contents recorded onto DVD 500 by AD server 100.

Also, in the above embodiment, AD server 100 joins each 15 of the device IDs stored in the registration information with CSI and uses the result in the encryption of content keys. However, AD server 100 may prestore the ID of devices having a DVD playback function, extract the ID of the devices capable of playing DVD, and concatenate each of these IDs with CSI for use in the 20 encryption of content keys.

(15) Although in the above embodiment, AD server 100 records contents onto a DVD, contents may be recorded onto a memory card, an MD, an MO, a CD, a BD (blu-ray disk) or the like, or 25 onto an IC card.

Also, apart from a playback apparatus, a client device may be a recording device or a combination of a playback apparatus

and a recording device. Also, a client device may, apart from being installed in a user's home or mounted in a vehicle, be a portable device capable of being carried by a user.

5 (16) IC card 400, because of being connected directly to AD server 100 or on-vehicle device 300, need not conduct SAC establishment processing.

10 (17) In the above embodiment, signature data, at a time of establishing a SAC, is generated with respect to data in which CSI is concatenated to random numbers *Cha\_B* or *Cha\_A*. However, a hash value of data that is to be a signature target may be calculated, and signature data may be generated with respect to this hash value.

15

(18) In the above embodiment, at a time of establishing a SAC, CSI is used when judging whether a device targeted for authentication is registered or unregistered and when sharing keys. However, CSI need only be used in one of these cases.

20 Also, although in the above embodiment, authentication is conducted in both directions (i.e. mutually), authentication may be only unidirectional.

(19) Registration of client devices may be restricted by time.

25 In this case, the time between AD server 100 and a client device is synchronized. AD server 100 sets a time period within which use of CSI is permitted as valid period information,

transmits the valid period information and CSI to the client device, and add "1" to the registered number.

The client device receives and stores the valid period information and the CSI. When the period shown by the valid 5 period information ends, the client device deletes the CSI.

AD server 100, once the period shown by the valid period information has ended, subtracts "1" from the registered number. If storing the device ID, AD server 100 deletes the ID of the device whose valid period has expired.

10 Moreover, the usage period information may show a date-time of the start/end of a usage period, or only the end date-time. Also, the usage period information may be information that sets restrictions on a period from the start of CSI usage, or may set restrictions on a period of operations by a client 15 device using the CSI.

(20) Although there is a single AD server per authorized domain in the above embodiment, there may be a plurality of AD servers in a single authorized domain.

In this case, a client device is able to select which 20 of the AD servers to communicate with. As a selection method, a user may make a setting, or a client device may select the AD server closest in the authorized domain to the client device in terms of distance. Also, a client device may select the AD server having the highest processing capacity or a low number 25 of other tasks.

Also, as described below, an AD server requested for registration by a client device may, when unable to register

the client device and the like, search for another AD server that is able to register the client device.

Specifically, the client device transmits a registration request to an AD server. When the registered number in the 5 requested AD server matches the maximum number, the requested AD server makes inquiries with another AD server as to whether the other AD server can register the client device. The other AD server, when able to register the client device, registers the client device that requested registration and notifies the 10 requested AD server that registration is possible, and the requested AD server, on receipt of the notification, transmits CSI to the client device.

Also, if the other AD server replies that registration of the client device is not possible, the AD server makes 15 inquiries with yet another AD server.

Also, one AD server may be selected to represent a plurality of AD servers, and the representative server may manage all of the in-group devices. In this case, when an AD server other than the representative server receives a registration request 20 from a client device, the AD server inquires as to whether the client device is registerable in the representative server, and if registerable, the client device is registered in the representative server, and receives CSI from the representative server via the AD server that received the request.

Moreover, if the representative server is currently 25 conducting other operations, or the like, the AD server may inquire with the other AD servers as to whether any of these

other AD servers are able to register the client device.

Also, as shown in (a) and (b) below, since a registered number of devices is managed among a plurality of AD servers, the AD servers may share a list relating to registered devices.

5 (a) When AD servers R and S within the same authorized domain each register client devices, the IDs of registered devices are stored as a device list. Also, whenever a list is updated by writing in IDs, the IDs are stored in the device list in correspondence with a version number.

10 AD servers R and S exchange device lists regularly or irregularly. AD server R compares the version number of the device list stored therein with the version number of the device list stored by AD server S, and stores the device list having the latest version number. AD server S conducts the same  
15 processing. In this way, it is possible for AD servers to always share the latest device list.

Moreover, device lists may be exchanged every time the device list of one of the AD servers is updated. Also, registration information such as registered numbers and maximum  
20 numbers may be shared in the same way as above.

(b) AD servers T and U within the same authorized domain hold device lists T and U, respectively, and at a time of registering a client device, store the device IDs of the client devices in correspondence with a registration time. AD servers  
25 T and U exchange device lists regularly or irregularly.

AD server T, if the registered number stored therein as registration information is less than the maximum number, writes

client devices newly registered in device list U received from AD server U into device list T stored therein, in the order of registration. Also, AD server U, in the same way, receives device list T, and updates device list U in the order in which 5 new client devices were registered.

Moreover, client devices may be provided in advance with a priority level, and priority can be given to the registration of devices having a high priority level. Also, when the combined number of client devices newly registered in AD servers T and 10 U exceeds the maximum number, priority may be given to the registration of devices having a high priority level, or a user may selected devices to be registered.

According to this method, even if the requested AD server is in a power-OFF state, a client device can be registered in 15 another AD server, and consistency maintained by exchanging device lists when the other server is updated, thus making it possible for AD servers to share the same device list.

(21) In order to avoid duplication of CSI among different 20 authorized domains, information exchange may be conducted between AD servers managing the different authorized domains, and confirmation made as to whether or not there is duplication.

Also, in order to improve safety, the AD servers may input respective CSI into a hash function to calculate a hash value, 25 and exchange the hash values to confirm whether or not there is duplication.

Also, instead of AD servers generating CSI, a management

authority may be provided, and the management authority may generate the CSI of all of the authorized domains so as to avoid duplication, and send respective CSI to the AD servers in a safe manner.

5

(22) Client devices may belong to a plurality of authorized domains.

The number of authorized domains in which a client device can register may be restricted by restricting the number of 10 pieces of CSI that the client device is able to store. Also, the present invention may be structured such that the number of authorized domains in which a client device can register is restricted by AD servers exchanging list information that shows registered client devices. Also, exchanging list 15 information makes it is possible to confirm the number of authorized domains to which client devices belong.

Otherwise, a management authority may be provided for managing the number of authorized domains in which a client device registers.

20 Also, a single AD server may manage a plurality of authorized domains. In this case, the number of pieces of different CSI that an AD server can store is restricted, and the AD server can manage authorized domains within this number. Also, the AD server may store the registerable number of client 25 devices per piece of CSI, or may store pieces of CSI in correspondence with group IDs.

(23) Authorized domains may each be allotted an identifier, and at a time of delivering a content, the device delivering the content may embed the identifier of the authorized domain in which the device is registered in the content as an electronic  
5 watermark.

In this way, it is possible to specify which authorized domain the content issued from, in the event of a content decrypted by a client device being improperly distributed outside of the authorized domain within which it originated.  
10 Furthermore, when a server that delivered the content manages the ID of client devices registered in various authorized domains, the ID of the client device that issued the content may be included in the CRL.

15 (24) Although in the above embodiment, contents are delivered to a device after successfully authenticating the device, the present invention is not limited to this.

Authentication need not be conducted at a time of content delivery in the following cases.

20 A device on the content transmission end generates an encryption key based on CSI, encrypts a content key using the generated encryption key, and transmits the encrypted content key and an encrypted content that was encrypted using the content key.

25 A device on the receiving end, on acquiring the encrypted content and encrypted content key, generates based on the CSI, a decryption key the same as the encryption key, decrypts the

encrypted content key using the decryption key to obtain a content key, and decrypts the encrypted content using the content key to obtain a content.

In this way, only a device that holds the CSI can generate  
5 the decryption key and decrypt the encrypted content.

Also, when an encrypted content is delivered first without authentication being conducted, and then authentication, as in the above embodiment, is conducted later to share a session key, and authentication is successful, the content key may be  
10 encrypted using the session key and delivered.

Moreover, the delivery of an encrypted content may be conducted by communication, or by recording the encrypted content onto a portable recording medium.

Also, even when there is no content delivery request or  
15 the like from a device on the receiving end, a device on the transmitting end may judge to conduct content delivery or the like, or may conduct content delivery or the like in accordance with an input from outside.

20 (25) In the above embodiment, a CSI storage unit stores "0" as an initial value, and on receipt of CSI generated by AD server 100, overwrites the initial value with the acquired CSI. However, the initial value and the CSI may be stored in separate areas. Also, when the acquired CSI is stored in a separate area to  
25 the initial value, the initial value may be deactivated.

Moreover, the deactivated initial value may be reactivated at a time of deleting CSI due to a transfer,

withdrawal, or the like.

Moreover, although the above was described in terms of "0" being stored as a value showing "unregistered", this value need not be "0", and may be any value that differs from the 5 value generated as CSI.

(26) Although in the above embodiment, AD server 100 permits IC card 400 to copy CSI one time, AD server 100 may permit a plurality of copies.

10 Also, IC card 400 may prevent CSI from being copied to the same client device more than once by, in addition to authenticating client devices using the CSI, storing the ID of client devices to which the CSI has been copied, and confirming the ID of client devices at a time of copying.

15 Also, an IC card may be implemented with the function of registering client devices, and a device connected to the IC card may operate as an AD server.

Also, a client device may be registered in an AD server as representing a plurality of client devices, and receive the 20 right to copy CSI to the plurality of client devices. An example of this is shown using Fig. 16.

An AD server 600 and a client device 601 are disposed in the home of a user, and client device 601 is already registered in AD server 600. AD server 600 stores a maximum number and 25 a remaining number as registration information, the maximum number and remaining number in the given example being 4 and 3, respectively.

On-vehicle devices 602, 603 and 604, which are not registered in AD server 600, are mounted in a vehicle owned by the user. On-vehicle devices 603 and 604 do not function to communicate directly with AD server 600. On-vehicle device 5 602 is portable and does function to communicate directly with AD server 600. Also, on-vehicle devices 602, 603 and 604 are connected to and can communicate with each another.

On-vehicle device 602, when connected to AD server 600 as a representative on-vehicle device, transmits a registration 10 request to AD server 600 that includes a desired number "3", which is the number of client devices on-vehicle device 602 seeks to register.

AD server 600, on receipt of the registration request, authenticates on-vehicle device 602 and shares a session key, 15 the same as in the above embodiment. If authentication is successful, AD server 600 judges whether the desired number in the registration request is less than or equal to the remaining number stored as registration information. If judged to be less than or equal to the remaining number, AD server 600 reads the 20 storedCSI, encrypts the readCSI and permission right permitting the registration of three devices, using the session key, and transmits the encrypted CSI and the encrypted permission right to on-vehicle device 602 as encrypted rights information.

On-vehicle device 602, on receipt of the encrypted rights 25 information, decrypts the encrypted CSI and permission right using the session key to obtain CSI and a permission right. Also, because 1-device worth of the permission right is used

in storing the obtained CSI, the permission right stored shows two devices to be registerable. Also, on-vehicle device 602 conducts authentication with on-vehicle devices 603 and 604, and if successful, transmits the CSI to on-vehicle devices 603 and 604 and reduces the number of registerable devices shown in the permission right.

In this way, on-vehicle devices 603 and 604 can be registered as client devices.

Moreover, if the remaining number is less than the desired 10 number, AD server 600 transmits a permission right permitting the registration of devices equal to the remaining number. As an example, when a permission right permitting the registration of two devices is transmitted, on-vehicle device 602 uses the permission right for 1 device in storing the obtained CSI, and 15 uses the remaining permission right for 1 device by transmitting the CSI to one of on-vehicle devices 603 and 604. The device to which the CSI is transmitted may be selected by the user, or each device may have a priority level, and the CSI transmitted to the device having the higher priority level.

20 Also, at a time of registering on-vehicle devices 602, 603 and 604 in AD server 600, the following processing is conducted when registering an ID of each on-vehicle device in AD server 600.

On-vehicle device 602, before registering, acquires the 25 IDs of on-vehicle devices 603 and 604. On-vehicle device 602, at a time of registering, transmits the acquired IDs and the ID of on-vehicle device 602 to AD server 600. AD server 600

stores the received IDs as device IDs. Also, if the remaining number is less than the desired number, AD server 600 stores, from the received IDs, IDs for how ever many devices is shown by the remaining number. In this case, the user may select which 5 IDs to register, or each ID may have a priority level, and IDs stored in a descending order of priority.

Also, when there is an excess of a permission right, it is possible for on-vehicle device 602 to return the excess to AD server 600.

Moreover, although on-vehicle device 602 is described above as acquiring a permission right that includes the right of on-vehicle device 602, on-vehicle device 602 may register with AD server 600 as described in the above embodiment, and then acquire the right to notify CSI to on-vehicle devices 603  
10 and 604.  
15

(27) A plurality of authorized domains may be combined to form a single authorized domain.

As an example, the combining of AD\_E and AD\_F to form  
20 AD\_G is described below using Fig. 17.

AD\_E and AD\_F are each structured from a single AD server and a plurality of client devices (not depicted). A maximum of "m" number of client devices is registerable in an AD server E in AD\_E, and devices registered in AD\_E each hold CSI\_E. Also,  
25 a maximum of "n" number of client devices is registerable in an AD server F in AD\_F, and devices registered in AD\_F each hold CSI\_F.

AD\_G is formed from these two authorized domains. First, a device to be AD server G managing AD\_G is determined from out of AD servers E and F. At this time, the device to be AD server G may be determined based on processing capacity, priority levels and the like, or may be determined by a user. The AD server that is not AD server G is registered in AD\_G as a client device.

A maximum of "k" number of devices registerable in AD server G is set as "m", "n" or the mean of "m" and "n". Also, AD server G newly generates CSI\_G, authenticates each of the client devices, and transmits CSI\_G to devices that are successfully authenticated.

If the aggregate number of devices forming AD\_E and AD\_F exceeds the maximum "k", devices for registration are selected. In this case, AD server G may make the selection based on predetermined priority levels, or the user may make the selection.

Moreover, apart from newly forming a single authorized domain from two existing authorized domains, one authorized domain may be added to the other authorized domain. When AD\_F is added to AD\_E, devices within AD\_F are registered in AD server E as AD\_E client devices, and hold CSI\_E. In this case, if the number of client devices for registration exceeds maximum "m", devices for registration may be selected as described above.

Moreover, "m", "n" and "k" are positive integers.

(28) A single authorized domain may be divided into a plurality

of authorized domains.

As an example, the forming of AD\_I and AD\_J from AD\_H is described below using Fig. 18.

AD\_H is structured from an AD server H and a plurality  
5 of client devices (not depicted).

AD server H is able to register "p" (positive integer) number of client devices, and devices registered in AD\_H each store CSI\_H.

AD server H, at a time of forming AD\_I and AD\_J, selects  
10 devices to be new AD servers I and J from client devices in AD\_H. At this time, devices having a high processing capability may be selected as AD servers, or the selection may be made based on the predetermined priority levels of devices. Also, a user may make the selection, or the selection may be made  
15 among client devices based on processing capability, priority levels and the like. Moreover, AD server H may form a new authorized domain as AD server I or AD server J.

After the division, client devices to belong to each authorized domain are selected. At this time, AD servers I and  
20 J may make respective selections based on priority levels, or the user may make the selection.

AD servers I and J can each register a maximum of "p" number of client devices. Also, once the client devices of each authorized domain have been selected, AD server I generates  
25 CSI\_I and transmits the generated CSI\_I to selected client devices. Also, AD server J, in the same way, generates CSI\_J and transmits the generated CSI\_J to selected client devices.

Moreover, AD servers I and J may conduct authentication every time a client device is selected or at a time of transmitting newly generated CSI.

Also, apart from newly forming two authorized domains  
5 from a single authorized domain as described above, one new authorized domain may be formed from AD\_H, and client devices divided between the original AD\_H and the new authorized domain.

(29) When a client device cuts a power supply, the client device  
10 may remain registered in an AD server, and CSI temporality deleted.

In this case, once a client device is registered in an AD server, the AD server stores an ID of the client device, and transmits CSI.

15 The client device, having stored the received CSI, is able to use contents as a device within the authorized domain managed by the AD server. The client device, on receipt of a power-OFF instruction, deletes the CSI and sets power off. At this time, the ID of the client device stored in the AD server  
20 is not deleted.

When the power supply of the client device is again set "on", the client device transmits the ID to the AD server. The AD server judges whether an ID matching the received ID exists among IDs stored therein, and again transmits the CSI to the  
25 client device without updating the registration information if judged that a matching ID exists.

Moreover, the CSI may also be temporarily deleted in the

event of cable or radio communication being interrupted, and when communication is reestablished, the ID may again be transmitted and the CSI again acquired.

5 (30) Although in the above embodiment, authentication is conducted using CSI, the following authentication processing  
(a) to (c) may be supplemented.

10 (a) Authenticate that a client device is connected to the same in-house LAN as an AD server, using a code uniformly provided by a system, or a MAC address, an IP address or the like. In this way, it becomes difficult to register the client device of another user/entity.

15 Also, when an AD server and a client device conduct radio communication, it may be authenticated that the client device is within range of the radio waves.

20 Also, when communication is possible between an AD server and a client device, authentication data may be transmitted from the AD server to the client device, and response data transmitted from the client device to the AD server. The AD server may clock the time period from transmission of the authentication data to reception of the response data, and if the clocked time is within a preset threshold, the client device may be authenticated as being located in-house.

25 Also, time-to-live (TTL) values may be set to be within the number of in-house routers, thus preventing the AD server from being able to communicate with out-house devices.

Also, it may be authenticated whether a client device

is located in-house by judging whether the client device is connected to the same power source as the AD server.

(b) Preset a password in an AD server, and at a time of registering a client device, the user manually inputs a password into the client device. The client device transmits a registration request to the AD server that includes the inputted password, and the AD server judges whether the received password included in the registration request matches the preset password.

10       Also, a plurality of passwords may be set, an example of which is each member of a family setting their own password. Also, an ID identifying a user may be combined with a password.

(c) Instead of a password as in (b) above, biomatrix information such as fingerprints, the iris, and the like may be used. In this way, it becomes possible for only a preset user to register a client device.

(31) An initial value held by a client device may be applied as described in (a) to (c) below.

20       (a) A client device holds a single initial value showing "not registered in AD server". When the client device registers with the AD server, the initial value is deactivated.

(b) A client device holds a plurality of initial values corresponding one-to-one with a plurality of AD servers. At 25 a time of registering with one of the AD servers, authentication is conducted using an initial value corresponding to the AD server, and if successful and the client device is registered,

the corresponding initial value is deactivated. Likewise, if the client device registers in another of the AD servers, an initial value corresponding to the other AD server is deactivated.

5       Moreover, each initial value may be identified in correspondence with an identifier of a group.

(c) A client device holds a single initial value showing "not registered in any AD server". When the client device registers with an AD server, the initial value is deactivated.

10      (32) The present invention may be a method showing the above. Also, this method may be computer program realized by a computer, or a digital signal formed from the computer program.

Also, the present invention may be a flexible disk, a hard disk, a CD-ROM, an MO, a DVD, a DVD-ROM, a DVD-RAM, a BD (blu-ray disk), a semiconductor memory or similar computer-readable recording medium that stores the computer program or the digital signal. Also, the present invention may be the computer program or digital signal recorded onto such 20 a recording medium.

Also, the present invention may be the computer program or the digital signal transmitted via a network or the like, representative examples of which include a telecommunication circuit, a radio or cable communication circuit, and the 25 Internet.

Also, the present invention may be a computer system that includes a microprocessor and a memory, the memory storing the

computer program and the microprocessor operating in accordance with the computer program.

Also, by transferring the computer program or the digital signal, either recorded on the recording medium or via a network 5 or the like, the present invention may be implemented by another independent computer system.

(33) The present invention may be any combination of the above embodiment and modifications.

10

#### CONTENT DUPLICATION MANAGEMENT SYSTEM 1000

Group formation/management system 1 described above is constructed so as to allow contents to be freely transmitted among devices within a group that is formed by AD server 100. 15 Hereinafter, description is given to a modification of the transmission of contents of which duplication is restricted. To this end, description is first given to a content duplication management system 1000 that manages content transmission in compliance with duplication restriction of each content.

Content duplication management system 1000 is a system 20 for receiving contents that are broadcast from a broadcast station or transmitted over a network, and for allowing the member devices of a group formed by AD server 100 to use the received contents. Hereinafter, description is given to an 25 example in which content duplication management system 1000 receives contents from a broadcast station.

<STRUCTURE>

First, description is given to a structure of content duplication management system 1000.

FIG. 19 is a view showing the structure of content duplication management system 1000. As shown in the figure, content duplication management system 1000 is structured from a home server 1100, a playback apparatus 1200, a playback apparatus 1300, a recording medium 1400, a gateway (GW) 1500, a playback apparatus 1600, and a broadcast station 1800.

In the figure, a solidline enclosing some of the components represents that those components are located within a household. Further, home server 1100, playback apparatus 1200, playback apparatus 1300, and gateway 1500 are mutually connected via the Ethernet. Recording medium 1400 is a portable recording medium that is mounted onto playback apparatus 1300 when put to use. Here, the network that is inside gateway 1500 (i.e. within the household) is referred to as a home network. The home network is connected to playback apparatus 1600, which is located outside the household, via gateway 1500 and Internet 1700.. In the system, home server 1100, playback apparatus 1200, playback apparatus 1300, and recording medium 1400 are members of a group formed by AD server 100, and thus share common secret information. Hereinafter, home server 1100, playback apparatus 1200, playback apparatus 1300, and recording medium 1400 may also be referred to as "in-group devices", while playback apparatus 1600 may also be referred to as an "out-group device".

1. Home Server 1100

FIG. 20 is a block diagram showing a structure of home server 1100. As shown in the figure, home server 1100 is structured from a data reception unit 1101, a signal processing unit 1102, an operation input unit 1103, a control unit 1104, a playback control unit 1105, a recordation control unit 1106, an IO (input/output) unit 1107, a storage unit 1108, a communication unit 1109, and a display unit 1110.

Home server 1100 is specifically a computer system structured from a CPU, a ROM, a RAM, a hard disk drive, a network interface, and the like. Home server 1100 carries out its functions by the CPU executing a computer program.

In this example, home server 1100 is assumed to be a DVD recorder, and thus structured to receive contents via terrestrial broadcasting. Yet, it is naturally appreciated that home server 1100 according to the present invention is not limited to a DVD recorder, and may be a personal computer. Home server 1100 may be structured to receive contents via Internet 1700.

(1) Data Reception Unit 1101

Data reception unit 1101 receives with an antenna, a broadcast wave that is broadcast from broadcast station 1800.

25

(2) Signal Processing Unit 1102

Signal processing unit 1102 generates content information

1121 from the broadcast wave received by data reception unit 1101, and outputs the generated content information 1121 to control unit 1104. To be more specific, signal processing unit 1102 extracts transport streams from the received broadcast 5 wave, accumulates the extracted transport streams to generate content information 1121.

FIG. 21 is a view showing a data structure of content information 1121. As shown in the figure, content information 1121 is composed of a content 1122 and duplication restricting 10 information 1123.

Content 1122 is digital data representing a movie, for example. Duplication restricting information 1123 is metadata about duplication of content 1122. Duplication restricting information 1123 is composed of a content identifier, a permitted 15 number of duplications, and a flag indicating whether content duplication to an out-group device is permitted.

The content identifier is a series of symbols that uniquely identifies the content. As shown in FIG. 21, the content identifier of content 1122 is "A-0001".

20 The permitted number of duplications represents the right to duplicate the content to another device up to that number of times. Note that the permitted number of duplications is a sum of two numbers that are permitted separately for duplications to a first type device and to a second type device. 25 The first type device refers to a device that duplicates a content to a non-portable recording medium, and the second type device refers to a device that duplicates a content to a portable

recording medium. As shown in the figure, the permitted number of duplications in content information 1121 is "10 (first type: 5, and second type: 5)", which means that it is permitted to duplicate the content to a first type device up to five times, 5 and to a second type device up to another five times.

The flag indicating whether content duplication to an out-group device is permitted is set to either "OK" or "NG". When set to "OK", the flag indicates that duplication of the content to an out-group device is permitted. When set to "NG", 10 on the other hand, the flag indicates that duplication of the content to an out-group device is prohibited. As shown in the figure, the flag in this embodiment is set to "NG", which means that duplication of content 1122 to an out-group device is prohibited.

15

### (3) Operation Input Unit 1103

Operation input unit 1103 is provided with a remote controller and an infrared photoreceiver. At a push of one of buttons on the remote controller by a user, operation input 20 unit 1103 generates an input signal corresponding to the pushed button, and outputs the generated input signal to control unit 1104.

Examples of an input signal that relates to a content duplication request are a content identifier identifying a 25 content requested to be duplicated, and a requested number of duplications.

(4) Control Unit 1104

Control unit 1104 is structured from a CPU, a ROM, a RAM, and the like, and performs overall control of home server 1100 by the CPU executing a computer program. When receiving an input signal from operation input unit 1103, control unit 1104 performs various types of processing, such as recordation processing, playback processing, duplication request processing, and duplication processing, according to the received input signal.

When performing the recordation processing, control unit 1104 receives a content from signal processing unit 1102, and outputs the received content to recordation control unit 1106.

When performing the playback processing to play a content that is received by data reception unit 1101, control unit 1104 receives the content from signal processing unit 1102, and outputs the received content to playback control unit 1105. When performing the playback processing to play a content that is stored in storage unit 1108 or that is recorded on a DVD-RAM mounted to IO unit 1107, control unit 1104 receives the content from storage unit 1108 or IO unit 1107, and outputs the received content to playback control unit 1105.

When performing the duplication request processing, control unit 1104 receives from operation input unit 1103, user input, such as a content identifier, a device identifier to which the duplication request is to be made, and a requested number of duplications. Note that the device identifier includes information representing whether a corresponding

device is a first type device of a second type device.

Control unit 1104 transmits a duplication request to the request destination device via communication unit 1109. The duplication request is composed of the requested number of 5 duplications, the content identifier, and the device identifier of the request destination device, and additionally of common secret information 1133 and a device identifier 1134 both stored in control unit 1104.

Next, description is given to the duplication processing.

10 As shown in FIG. 22, control unit 1104 is structured from an authentication unit 1131 and a duplication restricting information update unit 1132 (hereinafter, simply referred to as update unit 1132). As shown in the figure, authentication unit 1131 stores therein common secret information 1133, device 15 identifier 1134, and a table 1135. Update unit 1132 stores therein tables 1136 and 1137.

Common secret information 1133 is information commonly stored in advance in all the in-group devices (home server 1100, playback apparatus 1200, playback apparatus 1300, and recording 20 medium 1400), and used to perform mutual authentication with another in-group device.

Device identifier 1134 is a series of symbols that uniquely identifies home server 1100. As shown in the figure, the device identifier 1134 of home server 1100 is "IDA".

25 Table 1135 is shows device identifiers correspondingly to subgroup identifiers. Each subgroup identifier identifies a subgroup to which a device identified by a corresponding device

identifier belongs. As shown in the figure, the device that is identified by the device identifier "IDA" (i.e. home server 1100) belongs to a "subgroup A". The device that is identified by the device identifier "IDB" belongs to a "subgroup B". The 5 device that is identified by the device identifier "IDC" belongs to a "subgroup C". The device that is identified by the device identifier "IDM" belongs to a "subgroup D".

Table 1136 shows whether it is permitted to duplicate a content from a device in one subgroup to a device in another 10 subgroup. In table 1136, the OK column on the left shows, for example, "A → B", which indicates that duplication of a content from a device in the subgroup A to a device in the subgroup B is permitted. Similarly, "A ← B" in the OK column indicates that duplication of a content from a device in the subgroup 15 B to a device in the subgroup A is permitted. On the other hand, the NG column on the right shows, for example, "B → C", which indicates that duplication of a content from a device in the subgroup B to a device in the subgroup C is prohibited. Similarly, "D → C" in the NG column indicates that duplication 20 of a content from a device in the subgroup D to a device in the subgroup C is prohibited.

Table 1137 shows maximum permissible number determined for a device in each subgroup. In other words, the table shows an upper limit to the permitted number of duplications that 25 each device can possibly holds. As shown in the figure, the maximum permissible number of duplications that a device in the subgroup A can hold is "first type: 5, and second type:

5". Similarly, the maximum permissible number of duplications  
that a device in the subgroup B can hold is "first type: 3,  
and second type: 2". The maximum permissible number of  
duplications that a device in the subgroup C can hold is "first  
5 type: 1, and second type: 1". The maximum permissible number  
of duplications that a device in the subgroup D can hold is  
"first type: 2, and second type: 2".

10 Note that tables 1135, 1136 and 1137 are commonly stored  
in advance in home server 1100, playback apparatus 1200, and  
playback apparatus 1300.

15 Authentication unit 1131 receives a duplication request  
from a request source device via communication unit 1109. The  
duplication request is composed of a content identifier, a device  
identifier identifying the request source device, the common  
secret information, and the requested number of duplications.

Authentication unit 1131 performs authentication using  
the received common secret information. The authentication  
performed herein is, for example, challenge/response type  
handshaking based on zero-knowledge proof. To be more specific,  
20 authentication between home server 1100 and the request source  
device is performed using a secret key that has been generated  
and shared according to secret-key sharing cryptography.

When it is judged through the authentication that the  
request source device is an out-group device, authentication  
25 unit 1131 transmits to the request source device via  
communication unit 1109, an error message informing that the  
duplication request has been rejected.

On the other hand, when it is judged through the authentication that the request source device is an in-group device, authentication unit 1131 updates duplication restricting information as shown in the following examples.

5        In a first example, authentication unit 1131 has received from a request source device, a duplication request composed of the content identifier "A-0001", the device identifier "IDB", and the requested number of duplications "3 (first type: 2, and second type: 1)".

10      With reference to the received device identifier "IDB", authentication unit 1131 judges that the request source device is a "first type" device.

Next, authentication unit 1131 identifies, with reference to table 1135 stored therein, its own subgroup and the subgroup 15 to which the request source device belongs. In this example, authentication unit 1131 storing the device identifier "IDA" is judged to be included in a member device of the "subgroup A", and the request source device of which device identifier is "IDB" is judged to be a member of the "subgroup B".  
20 Accordingly, authentication unit 1131 passes to update unit 1132, the request destination subgroup identifier "subgroup A", the request source subgroup identifier "subgroup B", and the requested number of duplications "3 (first type: 2, and second type: 1)".

25      Update unit 1132 receives from authentication unit 1131, the request destination subgroup identifier "subgroup A", the request source subgroup identifier "subgroup B", and the

requested number of duplications "3 (first type: 2, and second type: 1)". Update unit 1132 then judges, with reference to table 1136, whether content duplication from a device in the "subgroup A" to a device in the "subgroup B" is permitted. Since 5 table 1136 shows "A → B" in the OK column, update unit 1132 accordingly judges that such duplication is permitted.

Update unit 1132 then judges, with reference to table 1137, whether the requested number of duplications "3 (first type: 2, and second type: 1)" falls within the maximum 10 permissible number of duplications determined for the request source device. Since table 1137 shows that the maximum permissible number of duplications determined for a device in the subgroup B is "first type: 3, and second type: 2", update unit 1132 judges that the requested number of duplications falls 15 within the maximum permissible number.

Update unit 1132 then identifies, via recordation control unit 1106, a requested content by the content identifier "A-0001" from among contents stored in storage unit 1108, and reads 20 duplication restricting information 1123 included in the identified content information 1121.

Update unit 1132 compares the permitted number of duplications shown by the read duplication restricting information 1123 with the requested number of duplications to see which is greater. Here, the permitted number of 25 duplications shown by duplication restricting information 1123 is "10 (first type: 5, and second type: 5)", so that it is judged that the requested number of duplications "3 (first type: 2,

and second type: 1)" is not greater than the permitted number.

When judging that the requested number of duplications is within the permitted number, update unit 1132 generates duplication restricting information 1124 to be transmitted to  
5 the request source device together with content 1122. As shown in FIG. 23A, duplication restricting information 1124 is composed of the content identifier "A-0001", the permitted number of duplications "3 (first type: 2, and second type: 1)", and the flag set to "NG", which indicates that content  
10 duplication to an out-group device is prohibited.

Update unit 1132 transmits content information 1125, which is composed of the generated duplication restricting information 1124 and the requested content 1122, to the request source device via communication unit 1109.

15 On receiving from the request source device via communication unit 1109, information notifying that content information 1125 has been fully received, update unit 1132 updates the duplication restricting information, so that duplication restricting information 1123 shown in FIG. 21 is  
20 altered to duplication restricting information 1126 shown in FIG. 23B.

To be more specific, update unit 1132 first subtracts from the permitted number of duplications "10 (first type: 5, and second type: 5)" shown by duplication restricting information 1123, the permitted number of duplications "3 (first type: 2, and second type: 1)" that has been transferred, as  
25 the duplication restricting information 1124, to the request

source device. Update unit 1132 then generates duplication restricting information 1126 with the subtraction result "7(first type: 3, and second type: 4)".

Update unit 1132 then attaches, via recordation control  
5 unit 1106, the thus generated duplication restricting information 1126 to content 1122 that is stored in storage unit 1108, thereby replacing the duplication restricting information 1123 with the duplication restricting information 1126.

10 Note that the description hereinafter is given on the supposition that home server 1100 stores content information 1127 (shown in FIG. 23B) that is composed of duplication restricting information 1126 and content 1122.

Now, description is given to a second example in which  
15 authentication unit 1131 has received from a request source device, a duplication request that is composed of the content identifier "A-0001", the device identifier "IDC", and the requested number of duplications "2 (first type: 1, and second type: 1)".

20 By the received device identifier "IDC", authentication unit 1131 judges that the request source device is a "first type" device.

Authentication unit 1131 judges, with reference to table  
1135 stored therein, that the device which includes  
25 authentication unit 1131 belongs to the "subgroup A", and the request source device belongs to the "subgroup C". Authentication unit 1131 then passes to update unit 1132, the

request destination subgroup identifier "subgroup A", the request source subgroup identifier "subgroup C", and the requested number of duplications "2 (first type: 1, and second type: 1)".

- 5        When receiving from authentication unit 1131, the request destination subgroup identifier "subgroup A", the request source subgroup identifier "subgroup C", and the requested number of duplications "2 (first type: 1, and second type: 1)", update unit 1132 judges, with reference to table 1136, that  
10      content duplication from a device in the "subgroup A" to a device in the "subgroup C" is permitted.

- Update unit 1132 then judges, with reference to table 1137, that the requested number of duplications "2 (first type: 1, and second type: 1)" falls within the maximum permissible  
15      number of duplications determined for a device in the "subgroup C".

- Update unit 1132 identifies, via recordation control unit 1106, content information that includes the content identifier "A-0001" from among pieces of content information stored in  
20      storage unit 1108, and reads duplication restricting information 1123 from the thus identified content information 1121.

- Update unit 1132 compares the permitted number of duplications shown by the read duplication restricting  
25      information 1123 and the requested number of duplications to see which is greater. As a result, update unit 1132 judges that the requested number of duplications "2 (first type: 1,

and second type: 1)" is not greater than the permitted number. Update unit 1132 then generates duplication restricting information 1151 that is to be transmitted to the request source device together with content 1122. As shown in FIG. 24A, 5 duplication restricting information 1151 is composed of the content identifier "A-0001", the permitted number of duplications "2 (first type: 1, and second type: 1)", and the flag set to "NG" indicating that content duplication to an out-group device is prohibited.

10           Update unit 1132 transmits to the request source device via communication unit 1109, content information 1150 that is composed of the generated duplication restricting information 1151 and the requested content 1122.

On receiving from the request source device via 15 communication unit 1109, information notifying that content information 1150 has been fully received, update unit 1132 updates the duplication restricting information, so that duplication restricting information 1126 shown in FIG. 23B is altered to duplication restricting information 1152 shown in 20 FIG. 24B. To be more specific, update unit 1132 first subtracts from the permitted number of duplications "7 (first type: 3, and second type: 4)" shown by the duplication restricting information 1126, the permitted number of duplications "2 (first type: 1, and second type: 2)" that has been transferred, as 25 duplication restricting information 1151, to the request source device. Update unit 1132 then generates duplication restricting information 1152 with the subtraction result "5

(first type: 2, and second type: 3".

Update unit 1132 attaches, via recordation control unit 1106, the generated duplication restricting information 1152 to content 1122 stored in storage unit 1108, thereby replacing 5 the duplication restricting information 1126 with the duplication restricting information 1152.

(5) Playback Control Unit 1105

Playback control unit 1105 receives from control unit 10 1104, a content generated by signal processing unit 1102, and outputs the received content to display unit 1110. In addition, playback control unit 1105 reads a content stored in storage unit 1108, and decodes the read content to output to display unit 1110. Further, playback control unit 1105 reads, via IO 15 unit 1107, a content recorded on a DVD-RAM that is mounted to IO unit 1107, and decodes the read content to output to display unit 1110.

(6) Recordation Control Unit 1106

20 Recordation control unit 1106 reads information from or write information to storage unit 1108 under instructions from control unit 1104. To be more specific, recordation control unit 1106 receives instructions from update unit 1132 included in control unit 1104. According to the instructions, 25 recordation control unit 1106 accesses storage unit 1108 to read duplication restricting information that is included in a content, and outputs the read duplication restricting

information to update unit 1132. Further, recordation control unit 1106 receives duplication restricting information from update unit 1132, and attaches the received duplication restricting information to a corresponding piece of content 5 information stored in storage unit 1108.

Further, recordation control unit 1106 reads information from, or writes information to a DVD-RAM via IO unit 1107 under instructions from control unit 1104.

10 (7) IO unit 1107

IO unit 1107 is specifically a DVD-RAM drive unit that writes information received from control unit 1104 via recordation control unit 1106 to a DVD-RAM being mounted thereto. Further, IO unit 1107 reads information from a DVD-RAM being 15 mounted thereto, and outputs the read information to playback control unit 1105 or to recordation control unit 1106.

(8) Storage Unit 1108

Storage unit 1108 is specifically a hard disk drive unit, 20 and stores contents that are broadcast from the broadcast station or transmitted from another device via communication unit 1109.

(9) Communication Unit 1109

Communication unit 1109 is separately connected to each 25 in-group device via the Ethernet, and performs transmission of duplication requests and requested contents between control unit 1104 and an in-group device.

When transmitting a content to an in-group device, communication unit 1109 encrypts the content with a secret key that is generated at the time of authentication. When receiving from an in-group device, a content that is encrypted using a 5 secrete key that is generated at the time of authentication, communication unit 1109 decrypts the encrypted content using the secret key and then outputs the decrypted content to control unit 1104.

10 (10) Display Unit 1110

Display Unit 1110 is specifically a display device, and displays a content outputted from playback control unit 1105.

2. Playback Apparatus 1200

15 FIG. 25 is a block diagram showing a structure of playback apparatus 1200. As shown in the figure, playback apparatus 1200 is structured from an operation input unit 1201, a control unit 1202, a playback control unit 1203, a recordation control unit 1204, a communication unit 1205, a display unit 1206, and 20 a storage unit 1207.

Playback apparatus 1200 is specifically a computer system structured from a CPU, a ROM, a RAM, a hard disk unit, a network interface, and the like. Playback apparatus 1200 carries out its functions by the CPU executing a computer program. In this 25 description, playback apparatus 1200 is assumed to be a hard disk recorder. Yet, it is naturally appreciated that playback apparatus 1200 according to the present invention is not limited

to a hard disk recorder, and may be a DVD recorder or a personal computer.

(1) Operation Input Unit 1201

5       Operation input unit 1201 is provided with a remote controller and an infrared photoreceiver. At a push of one of buttons on the remote controller by a user, operation input unit 1201 generates an input signal corresponding to the pushed button, and outputs the generated input signal to control unit  
10      1202.

(2) Control Unit 1202

Control unit 1202 is structured from a CPU, a ROM, a RAM, and the like, and performs overall control of playback apparatus  
15      1200 by the CPU executing a computer program. When receiving an input signal from operation input unit 1201, control unit 1202 performs various types of processing, such as recordation processing, playback processing, duplication request processing, and duplication processing, according to the  
20      received input signal.

As shown in FIG. 26, control unit 1202 is structured from an authentication unit 1211 and a duplication restricting information update unit 1212 (hereinafter, simply referred to as update unit 1212). Authentication unit 1211 stores therein common secret information 1213, a device identifier 1214, and table 1135. Update unit 1212 stores therein tables 1136 and 1137.

Common secret information 1213 is information commonly stored in advance in all the in-group devices, and used to perform mutual authentication with another in-group device.

Device identifier 1214 is a series of symbols that uniquely 5 identifies playback apparatus 1200. As shown in the figure, the device identifier 1214 of playback apparatus 1200 is "IDB".

Tables 1135, 1136, and 1137 are similar to the corresponding ones stored in control unit 1104 of home server 1100, and thus denoted by the similar reference numerals and 10 the description thereof is omitted.

When performing the recordation processing, control unit 1202 receives a content from communication unit 1205, and outputs the received content to recordation control unit 1204.

When performing the playback processing, control unit 15 1202 outputs an instruction to playback control unit 1203, so that playback control unit 1203 reads a content from storage unit 1207 and decodes the read content.

When performing the duplication request processing, control unit 1202 receives, from operation input unit 1201, 20 user input, such as a content identifier, a device identifier of a request destination device, and a requested number of duplications. Control unit 1202 transmits a duplication request to the request destination device via communication unit 1205. The duplication request is composed of the content identifier, the device identifier of the request destination device, and the requested number of duplications, and 25 additionally of common secret information 1213 and device

identifier 1214 both are stored in control unit 1202.

When performing duplication processing, authentication unit 1211 receives a duplication request from a request source device via communication unit 1205. The duplication request 5 is composed of a content identifier, a device identifier, common secret information, and a requested number of duplications. Authentication unit 1211 then performs challenge/response type handshaking based on zero-knowledge proof using the received common secret information in order to judge whether the request 10 source device is an in-group device.

When it is judged through the authentication that the request source device is an out-group device, authentication unit 1211 transmits to the request source device via communication unit 1205, an error message informing that the 15 duplication request has been rejected.

On the other hand, when it is judged through the authentication that the request source device is an in-group device, authentication unit 1211 updates duplication restricting information in the following manner.

20 The description hereinafter is given on the supposition that playback apparatus 1200 has received content information 1125 shown in FIG. 23A from home server 1100 and stores the received content 1125 in storage unit 1207.

In a first example, authentication unit 1211 has received 25 a duplication request composed of the content identifier "A-0001", the device identifier "IDC", common secret information 1313, and the requested number of duplications "2

(first type: 1, and second type: 1)".

With reference to the received device identifier "IDC", authentication unit 1211 judges that the request source device is a "first type" device.

5 Authentication unit 1211 identifies, with reference to table 1135, its own subgroup and the subgroup to which the request source device belongs. In this example, authentication unit 1211 storing the device identifier "IDB" is judged to be included in a member device of the "subgroup B", and the request source 10 device of which device identifier is "IDC" is judged to be a member of the "subgroup C". Accordingly, authentication unit 1211 passes to update unit 1212, the request destination subgroup identifier "subgroup B", the request source subgroup identifier "subgroup C", and the requested number of duplications "2 (first 15 type: 1, and second type: 1)".

Update unit 1212 receives from authentication unit 1211, the request destination subgroup identifier "subgroup B", the request source subgroup identifier "subgroup C", and the requested number of duplications "2 (first type: 1, and second 20 type: 1)". Update unit 1212 then judges, with reference to table 1136, whether content duplication from a device in the "subgroup B" to a device in the "subgroup C" is permitted. Since table 1136 shows that "B → C" in the NG column, update unit 1212 accordingly judges that such duplication is prohibited. 25 In this case, update unit 1212 outputs to the request source device an error message informing that the duplication request has been rejected.

In a second example, authentication unit 1211 has received a duplication request composed of the content identifier "A-0001", the device identifier "IDM", common secret information 1411, and the requested number of duplications "3  
5 (first type: 2, and second type: 1)".

With reference to the received device identifier "IDM", authentication unit 1211 judges that the request source device is a "second type" device.

Authentication unit 1211 identifies, with reference to  
10 table 1135, its own subgroup and the subgroup to which the request source device belongs. In this example, authentication unit 1211 storing the device identifier "IDB" is judged to be included in a member device of the "subgroup B", and the request source device of which device identifier is "IDM" is judged to be a  
15 member of the "subgroup D". Accordingly, authentication unit 1211 passes to update unit 1212, the request destination subgroup identifier "subgroup B", the request source subgroup identifier "subgroup D", and the requested number of duplications "3 (first type: 2, and second type: 1)".

20 Update unit 1212 receives from authentication unit 1211, the request destination subgroup identifier "subgroup B", the request source subgroup identifier "subgroup D", and the requested number of duplications "3 (first type: 2, and second type: 1)". Update unit 1212 then judges, with reference to  
25 table 1136, whether content duplication from a device in the "subgroup B" to a device in the "subgroup D" is permitted. Since table 1136 shows that "B → D" in the OK column, update unit

1212 judges that such duplication is permitted.

Update unit 1212 then judges, with reference to table 1137, whether the requested number of duplications "3 (first type: 2, and second type: 1)" falls within the maximum  
5 permissible number of duplications determined for the request source device. Since table 1137 shows that the maximum permissible number of duplications determined for a device in the subgroup B is "first type: 3, and second type: 2", update unit 1212 judges that the requested number of duplications falls  
10 within the maximum permissible number.

Update unit 1212 then identifies, via recordation control unit 1204, a requested content by the content identifier "A-0001" from among contents stored in storage unit 1207, and reads the duplication restricting information 1124 included in the  
15 identified content information 1125.

Update unit 1212 compares the permitted number of duplications shown by the read duplication restricting information 1124 with the requested number of duplications to see which is greater. Here, the permitted number of  
20 duplications shown by duplication restricting information 1124 is "3 (first type: 2, and second type: 1)", so that it is judged that the requested number of duplications "3 (first type: 2, and second type: 1)" is not greater than the permitted number.

When judging that the requested number of duplications  
25 is within the permitted number, update unit 1212 generates duplication restricting information 1161 to be transmitted to the request source device together with content 1122. As shown

in FIG. 27, duplication restricting information 1161 is composed of the content identifier "A-0001", the permitted number of duplications "3 (first type: 2, and second type: 1)", and the flag set to "NG", which indicates that content duplication to  
5 an out-group content is prohibited.

Update unit 1212 transmits content information 1162, which is composed of the generated duplication restricting information 1161 and content 1122, to the request source device via communication unit 1205.

10 On receiving from the request source device via communication unit 1205, information notifying that content information 1162 has been fully received, update unit 1212 updates the duplication restricting information by subtracting from the permitted number of duplication shown by duplication  
15 restricting information 1124, the permitted number of duplications "3 (first type: 2, and second type: 1)" that has been transferred, as the duplication restricting information 1161, to the request source device. In this case, the duplication restricting information 1124 generated with the subtraction result shows the permitted number of duplication "0(first type: 0, and second type: 0)". When the permitted number of duplications becomes "0", update unit 1212 erases, via recordation control unit 1204, content information 1125 stored in storage unit 1207.  
20

25

### (3) Playback Control Unit 1203

Under instructions from control unit 1202, playback

control unit 1203 reads a content from storage unit 1207, decodes the read content, and outputs the decoded content to display unit 1206.

5 (4) Recordation Control Unit 1204

Recordation control unit 1204 reads information from, and writes information to storage unit 1207 under instructions from control unit 1207.

To be more specific, recordation control unit 1204 receives instructions from update unit 1212 of control unit 1202. According to the instructions, recordation control unit 1204 accesses storage unit 1207 to read duplication restricting information that is included in a content, and outputs the read duplication restricting information to update unit 1212. Further, recordation control unit 1204 receives duplication restricting information from update unit 1212, and attaches the received duplication restricting information to a corresponding piece of content information stored in storage unit 1207.

20

(5) Communication Unit 1205

Communication unit 1205 is separately connected to each in-group device via the Ethernet, and performs transmission of duplication requests and requested contents between control unit 1202 and an in-group device.

When transmitting a content to an in-group device, communication unit 1205 encrypts the content with a secret key

that is generated at the time of authentication. When receiving from an in-group device, a content that is encrypted using a secrete key that is generated at the time of authentication, communication unit 1205 decrypts the encrypted content using 5 the secret key and then outputs the decrypted content to control unit 1202.

(6) Display Unit 1206

Display Unit 1206 is specifically a display device, and 10 displays a content outputted from playback control unit 1203.

(7) Storage Unit 1207

Storage unit 1207 is specifically a hard disk drive unit, and stores contents that are written by recordation control 15 unit 1204.

3. Playback Apparatus 1300

FIG. 28 is a block diagram showing a structure of playback apparatus 1300. As shown in the figure, playback apparatus 20 1300 is structured from an operation input unit 1301, a control unit 1302, a playback control unit 1303, a recordation control unit 1304, a communication unit 1305, a display unit 1306, an IO unit 1307, and a storage unit 1308.

Playback apparatus 1300 is specifically a computer system 25 structured from a CPU, a ROM, a RAM, a hard disk unit, a network interface, a memory card slot, and the like. Playback apparatus 1300 carries out its functions by the CPU executing a computer

program. In this description, playback apparatus 1300 is assumed to be a memory card recorder with a built-in HDD. Playback apparatus 1300 records a content to the hard disk, and plays the content recorded on the hard disk. In addition, 5 with a portable recording medium, such as a memory card, being inserted into the memory card slot, playback apparatus 1300 records a content to the recording medium, and plays a content recorded on the recording medium. That is to say, playback apparatus 1300 acts as a first type device when recording a content 10 to the built-in hard disk, and as a second type device when recording a content to a portable recording medium, such as a memory card.

Note that playback apparatus 1300 according to the present invention is not limited to a memory card recorder with a built-in 15 HDD, and may be a DVD recorder or a personal computer as long as it is capable of inputting a content to, or outputting a content from a portable recording medium.

#### (1) Operation Input Unit 1301

20 Operation input unit 1301 is provided with a remote controller and an infrared photoreceiver. At a push of one of buttons on the remote controller by a user, operation input unit 1301 generates an input signal corresponding to the pushed button, and outputs the generated input signal to control unit 25 1302.

#### (2) Control Unit 1302

Control unit 1302 is structured from a CPU, a ROM, a RAM, and the like, and performs overall control of playback apparatus 1300 by the CPU executing a computer program. When receiving an input signal from input operation input unit 1301, control 5 unit 1302 performs various types of processing according to the received signal. The various types of processing include recordation processing, playback processing, duplication request processing, duplication processing, and processing to duplicate a content to recording medium 1400.

10 As shown in FIG. 29, control unit 1302 is structured from an authentication unit 1311 and a duplication restricting information update unit 1312 (hereinafter, simply referred to as update unit 1312). Authentication unit 1311 stores therein common secret information 1313, a device identifier 1314, and 15 a table 1135. Update unit 1312 stores therein tables 1136 and 1137.

Common secret information 1313 is information commonly stored in advance in all the in-group devices, and used to perform mutual authentication with another in-group device.

20 Device identifier 1314 is a series of symbols that uniquely identifies playback apparatus 1300. As shown in the figure, the device identifier 1214 of playback apparatus 1300 is "IDC".

Tables 1135, 1136, and 1137 are similar to the corresponding ones stored in control unit 1104 that is included 25 in home server 1100, and thus denoted by the similar reference numerals and the description thereof is omitted.

When performing the recordation processing, control unit

1302 receives a content from communication unit 1305, and outputs the received content to recordation control unit 1204 or to IO unit 1307.

When performing the playback processing, control unit 5 1302 outputs an instruction to playback control unit 1303, so that playback control unit 1303 reads a content from recording medium 1400 via IO unit 1307 or from storage unit 1308, and decodes the read content.

When performing the duplication request processing, 10 control unit 1302 transmits a duplication request to a request destination device via communication unit 1305. The duplication request is composed of common secret information 1313 and device identifier 1314, both of which stored in control unit 1302, in addition to a content identifier, a device 15 identifier of the request source device, and a requested number of duplications, each of which are received from operation input unit 1301.

For example, through the duplication request processing, control unit 1302 receives content information 1150 shown in 20 FIG. 24A from home server 1100, via communication unit 1305. Content information 1150 is composed of duplication restricting information 1151 and content 1122. Duplication restricting information 1151 is composed of the content identifier "A-0001", the permitted number of duplications "2 (first type: 1, and 25 second type: 1)", and the flag set to "NG", which indicates that content duplication to an out-group device is prohibited.

When performing duplication processing, authentication

unit 1311 receives a duplication request from a request source device via communication unit 1305. The duplication request is composed of the content identifier, the device identifier, the common secret information, and the requested number of 5 duplications. Authentication unit 1311 then performs challenge/response type handshaking based on zero-knowledge proof using the received common secret information in order to judge whether the request source device is a device connected to the home network, i.e., an in-group device.

10 When it is judged through the authentication that the request source device is an out-group device, authentication unit 1311 transmits to the request source device via communication unit 1305, an error message informing that the duplication request has been rejected.

15 On the other hand, when it is judged through the authentication that the request source device is an in-group device, authentication unit 1311 and update unit 1312 generate duplication restricting information with reference to tables 1135, 1136, and 1137 in a similar manner to home server 1100 20 and playback apparatus 1200. Authentication unit then transmits to the request source device via communication unit 1305, content information that is composed of the generated duplication restricting information and the content.

Further, update unit 1312 updates duplication restricting 25 information corresponding to the transmitted content stored in storage unit 1308. In the case where the updated duplication restricting information shows the permitted number of

duplications "0", update unit 1312 erases the content.

Next, description is given to operations performed by control unit 1302 in the case where recording medium 1400 is mounted to IO unit 1307.

5

#### Duplication Request Processing

The duplication request processing is performed when control unit 1302 receives from operation input unit 1301, an instruction to duplicate a content to recording medium 1400.

- 10 In response to the instruction, control unit 1302 reads common secret information 1411 and device identifier 1412 both from recording medium 1400 via IO unit 1307, and transmits a duplication request information to the request destination device via communication unit 1305. The duplication request
- 15 is composed of the common secret information 1411 and device identifier 1412, both of which are read from the recording medium 1400, and the content identifier, the device identifier of the request destination device, and the requested number of duplications, each of which is received from operation input
- 20 unit 1301.

- 25 In response to the request issued through the duplication request processing, playback apparatus 1200, for example, transmits content information 1162 shown in FIG. 27. As a result, control unit 1302 receives via communication unit 1305 the transmitted content information 1162, and outputs the received content information 1162 to recording medium 1400 via IO unit 1307.

## Duplication Processing

Next, description is given to the operations performed by control unit 1302 when receiving a duplication request for  
5 a content recorded on recording medium 1400.

Here, description is given to an example in which authentication unit 1311 has received a duplication request that is composed of the content identifier "A-0001", the device identifier "IDA", common secret information 1133, and the  
10 requested number of duplications "2 (first type: 1, and second type: 1)".

Note that the duplication request received herein includes information showing that the request source device (home server 1100) already stores the content identified by  
15 the content identifier "A-0001", and the duplication restricting information attached to the content shows the permitted number of duplications "5 (first type: 2, and second type: 3)".

Authentication unit 1311 outputs the received common  
20 secret information 1133 to recording medium 1400 via IO unit 1307.

When receiving from IO unit 1307, information indicating that authentication of the request source device has failed and thus the request source device has been identified as an  
25 out-group device, authentication unit 1311 transmits to the request source device, an error message so as to inform that the duplication request has been rejected. On the other hand,

when receiving from IO unit 1307 that the request source device has been successfully authenticated, and thus identified as an in-group device, authentication unit 1311 judges, with reference to table 1135, to which subgroup each of recording 5 mediums 1400 and request source device belongs. In this example, the recording medium 1400 having the device identifier "IDM" is judged to be a member of the "subgroup D", and the request source device having the device identifier "IDA" is judged to be a member of the "subgroup A".

10 Note that authentication unit 1311 is structured so as to receive, when recording medium 1400 is mounted to IO unit 1307, the device identifier "IDM" from recording medium 1400.

Authentication unit 1311 then passes to update unit 1312, the request destination subgroup identifier "subgroup D", the 15 request source subgroup identifier "subgroup A", and the requested number of duplications "2 (first type: 1, and second type: 1)".

Update unit 1312 receives from authentication unit 1311, the request destination subgroup identifier "subgroup D", the 20 request source subgroup identifier "subgroup A", and the requested number of duplications "2 (first type: 1, and second type: 1)". Update unit 1312 then judges, with reference to table 1136, whether content duplication from a device in the "subgroup D" to a device in the "subgroup A" is permitted. Since 25 table 1136 shows that "D → A" in the OK column, update unit 1312 judges that such duplication is permitted.

Update unit 1132 then judges, with reference to table

1137, whether the sum of the requested number of duplications  
“2 (first type: 1, and second type: 1)” and the permitted number  
of duplications that is already held by the request source device  
(home server 1100) falls within the maximum permissible number  
5 of duplications determined for the request source device.  
Since table 1137 shows that the maximum permissible number of  
duplications determined for devices in the subgroup A is “first  
type: 5, and second type: 5”, update unit 1312 judges that the  
sum of the requested number of duplications and the already  
10 held permitted number of duplications falls within the maximum  
permissible number.

Update unit 1312 then identifies, by the content  
identifier “A-0001”, content information including the  
requested content from among contents stored in recording medium  
15 1400, and then reads, via IO unit 1307, duplication restricting  
information 1161 included in the identified content information  
1162 (shown in FIG. 27).

Update unit 1312 compares the permitted number of  
duplications shown by duplication restricting information 1161  
20 with the requested number of duplications to see which is greater.  
Here, the permitted number of duplications is “3: (first type:  
2, and second type: 1)”, so that it is judged that the requested  
number of duplications “2 (first type: 1, and second type: 1)”  
is not greater than the permitted number.

25 When judging that the requested number of duplications  
is within the permitted number, update unit 1312 outputs an  
instruction to home server 1100 via communication unit 1305.

The instruction is to have home server 1100 add the requested number of duplications "2 (first type: 1, and second type: 1)" to the permitted number of duplications stored in home server 1100, correspondingly to the content identifier "A-0001".

5        In response, home server 1100 updates the stored duplication restricting information 1152 included in content information 1153 (shown in FIG. 24B) by adding the requested number of duplications "2 (first type: 1, and second type: 1)" to the currently held permitted number of duplications. FIG.  
10      30A shows the updated content information 1172 that includes duplication restricting information 1171.

Next, update unit 1312 receives from home server 1100 via communication unit 1305, information notifying that duplication restricting information has been updated. In  
15      response, update unit 1312 updates the duplication restricting information stored in recording medium 1400 by subtracting the requested and thus transferred, permitted number of duplications "2 (first type: 1, and second 1)" from the permitted number of duplications shown by duplication restricting information in content information 1161. FIG. 30B shows the  
20      updated duplication restricting information 1181.

In the case where the permitted number of duplications after the subtraction becomes "0", update unit 1312 erases the content recorded on recording medium 1400.

25

(3) Playback Control Unit 1303

Under instructions from control unit 1302, playback

control unit 1303 reads a content from storage unit 1308, and decodes the read content to output to display unit 1306.

(4) Recordation Control Unit 1304

5       Under instructions from control unit 1302, recordation control unit 1304 reads information from, and writes information to storage unit 1308. Further, also under instruction from control unit 1302, recordation control unit 1304 reads information from, and write information to recording medium  
10 1400 via IO unit 1307.

To be more specific, recordation control unit 1304 receives instructions from update unit 1312 of control unit 1302. According to the instructions, recordation control unit 1304 accesses storage unit 1308 to read duplication restricting  
15 information that is attached to a content, and outputs the read duplication restricting information to update unit 1312. Further, recordation control unit 1304 receives duplication restricting information from update unit 1312, and attaches the received duplication restricting information to a  
20 corresponding content stored in storage unit 1308.

(5) Communication Unit 1305

Communication unit 1305 is connected to each in-group device via the Ethernet, and performs transmission of  
25 duplication requests and requested contents between control unit 1302 and an in-group device.

When transmitting a content to an in-group device,

communication unit 1305 encrypts the content with a secret key that is generated at the time of authentication. When receiving from an in-group device, a content that is encrypted using a secret key that is generated at the time of authentication,  
5 communication unit 1305 decrypts the encrypted content using the secret key and then outputs the decrypted content to control unit 1302.

(6) Display Unit 1306

10 Display Unit 1306 is specifically a display device, and displays a content outputted from playback control unit 1303.

(7) IO Unit 1307

15 IO unit 1307 is, for example, a memory card slot to which recording medium 1400, exemplified by a portable recording medium such as a memory card, is mountable. When recording medium 1400 is mounted thereto, IO unit that writes information received from control unit 1302 to recording medium 1400 via recordation control unit 1304. Further, IO unit 1307 reads  
20 information from recording medium 1400, and outputs the read information to control unit 1302, playback control unit 1303, or to recordation control unit 1304.

(8) Storage Unit 1308

25 Storage unit 1308 is specifically a hard disk drive unit, and stores contents that are written by recordation control unit 1304.

#### 4. Recording Medium 1400

As shown in FIG. 31, recording medium 1400 is structured from an IO unit 1401, a control unit 1402, and a storage unit 5 1403.

Recording medium 1400 is a portable recording medium provided with an IC chip, and thus capable of performing authentication. In this example, the recording medium 1400 is assumed to be a memory card.

10 When mounted onto IO unit 1307 of playback apparatus 1300, recording medium 1400 receives a content stored in storage unit 1308 of recording apparatus 1300, and stores the received content to storage unit 1403. In addition, when mounted onto IO unit 1307 of playback apparatus 1300, recording medium 1400 is 15 connected to the home network, which allows the recording medium 1400 to receive a content from an in-group device connected to the home network, and store the received content to storage unit 1403. Further, recording medium 1400 is allowed to transmit a content stored in the storage unit 1403 to an in-group 20 device via the home network.

##### (1) IO Unit 1401

When recording medium 1400 is mounted to IO unit 1307 of playback apparatus 1300, IO unit 1401 performs input and 25 output of data between control unit 1402 and control unit 1300 that is included in playback apparatus 1300.

.. .

(2) Control Unit 1402

As shown in FIG. 31, control unit 1402 stores therein common secret information 1411 and a device identifier 1412. Common secret information 1411 is shared in advance by all the 5 in-group devices, and used to perform mutual authentication with another in-group device. Device identifier 1412, which reads "IDM" in this example, is a series of symbols that uniquely identifies recording medium 1400. When recording medium 1400 is mounted to playback apparatus 1300, control unit 1402 outputs 10 the device identifier "IDM" to control unit 1302.

When playback apparatus 1300 receives a duplication request from a request source device, control unit 1402 receives via playback apparatus 1300, common secret information that is include in the received duplication request. Through the 15 use of the received common secret information, control unit 1402 performs challenge/response type handshaking using the received common secret information in order to judge whether the request source device is an in-group device.

Control unit 1402 transmits the judgment result to IO 20 unit 1401 and also to control unit 1302 via IO unit 1307.

Further, control unit 1402 writes to storage unit 1403, content information received from playback apparatus 1300 via IO unit 1401. In one example, control unit 1402 receives via 25 playback apparatus 1300, content information 1162 shown in FIG. 27, and writes the received content information 1162 to storage unit 1403.

Still further, control unit 1402 reads, in response to

a duplication request received via playback apparatus 1300 via IO unit 1401, content information from storage unit 1403, and outputs the read content information to playback apparatus 1300 via IO unit 1401.

5

(3) Storage Unit 1403

Storage unit 1403 is a tamper-resistant memory area that stores content information written by control unit 1403.

10 6. Playback Apparatus 1600

Playback apparatus 1600 is not illustrated in a figure as it is similar in structure to playback apparatus 1200 or 1300.

15 Playback apparatus 1600 is connected to the home network via the internet 1700. Playback apparatus 1600 is an out-group device and is not provided with the common secret information. Consequently, playback apparatus 1600 is not allowed to receive duplication of a content from an in-group device.

20 <OPERATIONS>

Hereinafter, description is given, with reference to a flowchart shown in FIGs. 32-35, to operations of content duplication management system 1000 for content duplication processing.

25 Note that description hereinafter is given in terms of information transmission performed between a content source device that issues a content duplication request, and a

duplication destination device that receives the content duplication request. Note that any of the in-group devices constituting the content duplication management system 1000 may act as a request destination device. Similarly, any of  
5 the in-group devices constituting the content duplication management system 1000 may act as a request source device.

The duplication source device receives, through user operations, a content identifier, a device identifier of a request destination device, and a requested number of  
10 duplications (step S1000).

Next, the request source device transmits a duplication request to the request destination device via the network and the request source device receives the duplication request (step S1002). The duplication request is composed of the content  
15 identifier, the device identifier identifying the request target device, the requested number of duplications, the common secret information, and the device identifier identifying the request source device.

On receiving the duplication request, the request  
20 destination device authenticates the request source device using the common secret information included in the duplication request (step S1003). When the authentication fails, thereby identifying the request source device as an out-group device (step S1004, NG), the request destination device transmits to  
25 the request source device, an error message informing that the duplication request has been rejected (step S1400). On the other hand, when the authentication is successively performed,

thereby identifying the request source device as an in-group device (step S1004, OK), the authentication unit of the request destination judges, with reference to table 1135 stored therein, to which subgroup the destination source device belong (step 5 S1005).

Next, the update unit judges, with reference to table 1136 stored therein, whether it is permitted to duplicate a content from the subgroup of the request destination device to the subgroup of the request source device (step S1006). When 10 it is judged that such duplication is prohibited (step S1007, NO), the update unit transmits to the request source device, an error message informing that the duplication request has been rejected (step S1008).

When receiving the error message (step S1010, YES), the 15 request source device terminates the processing. On the other hand, when no error message is received (step S1010, NO), the request source device continues the processing.

When it is judged in the step S1006 that such duplication is permitted (step S1007, YES), the update unit judges, with 20 reference to table 1137 stored there, whether the requested number of duplications is not greater than a maximum permissible number for the subgroup of the request source device (step S1009). When it is judged that the requested number is greater than the maximum permissible number shown in table 1137 (step S1100, 25 NO), the update unit replaces the requested number with the maximum permissible number (step S1101) and goes on to the next step.

Next, the update unit identifies, via the recordation control unit, a requested content (step S1102). Update unit then reads the permitted number of duplications from the content information that is attached to the identified content (step 5 S1103). When the requested number of duplications is greater than the read permitted number of duplications (step S1104, NO), the update unit designates the read permitted number as the number of duplications (step S1105). On the other hand, when the read permitted number of duplications is not greater 10 than the requested number of duplications (step S1104, YES), the update unit designates the requested number of duplications as the number of duplications. The update unit then generates duplication restricting information to be attached to the content that is to be transmitted to the request source device 15 (step S1106).

The request source device reads the content identified in the step S1102 from the storage unit, and transmits to the request source device, the content information that is composed of the read content along with the generated duplication 20 restricting information attached thereto (step S1107). When the request source device completes reception of the content information, the request source device transmits information notifying completion of the reception, and the request destination device receives the information (step S1108). The 25 request source device stores the received content information (step S1109). On receiving the information notifying completion of the reception, the request destination device

updates the duplication restricting information in the corresponding piece of content information stored in the storage unit (step S1110).

In the case where the permitted number of duplications  
5 shown by the updated duplication restricting information is "0" (step S1200, YES), the update unit erases the content information from the storage unit (step S1201), and terminates the processing.

Note that the recording medium is not provided with update  
10 unit for generating the duplication restricting information although it is provided with the control unit for performing the authentication. Therefore, when the recording medium acts as the request destination device, the operations that are otherwise performed by the request destination device in the  
15 step S1006 and thereafter are performed by the control unit of the playback apparatus to which the recording medium is mounted.

<MODIFICATIONS OF CONTENT DUPLICATION MANAGEMENT SYSTEM 1000>

20 Up to this point, the present invention has been described by way of the content duplication management system 1000 as an embodiment. It is naturally understood that the present invention is in no way limited to the specific embodiment described above, and various modifications such as those  
25 described below are within the scope of the present invention.

(1) Although in the above embodiment, the control unit of

each device stores tables 1135, 1136, and 1137, those tables may be included in content information as meta data of a content. This modification still falls within the scope of the present invention.

5       In this case, home server 1100 may be structured to receive content information from broadcast station 1800, and to attach tables 1135, 1136, and 1137 to the received content information. In response to a request from a request source device, home server 1100 transmits to the request source device, the content 10 information that is composed of a requested content, duplication restricting information, and tables 1135, 1136, and 1137. Tables 1135, 1136, and 1137 may be stored in the home server in advance, or may be generated by a user.

15     (2)     The subgroups within the house hold may be formed by the user. For example, the user may operate a remote controller of home server 1100 so as to classify and register home server 1100 into the "subgroup A", playback apparatus 1200 into "the subgroup B", and playback apparatus 1300 into the "subgroup 20 C".

Further, home server 1100 may be structured to generate tables 1135, 1136, and 1137 in response to the user operations for subgroup registrations, and to transmit the generated tables as meta data of a content or separately from a content to each 25 in-group device.

(3)     In content duplication management system 1000 described

in the above embodiment, the flag is always set to "NG", thereby indicating that transmission of content information to an out-group device is prohibited. It is naturally appreciated that the present invention is not limited this embodiment.

For example, content information may be transmitted to an out-group device on the condition that further duplication to another device is prohibited. This modification still falls within the scope of the present invention.

To be more specific, description hereinafter is given, with reference to a flowchart shown in FIG. 35, to operations performed when there are both types of content information, one having a flag set to "OK" and the other having a flag set to "NG".

When the authentication fails in the step S1004 shown in FIG. 32, i.e. the request source device is identified as an out-group device, the request destination device goes on to a step S1300 shown in FIG. 35.

The request destination device identifies a requested content (step S1300), and reads from the duplication restricting information attached to the identified content, the flag indicates whether duplication of the content is permitted (step S1301). When the flag is set to "NG" (step S1302, NG), the request destination device transmits an error message to the out-group device acting as the request source device in order to inform that the duplication request has been rejected (step S1303).

On the other hand, when the flag is set to "OK" (step

S1302, OK), the request destination device generates duplication restricting information showing the permitted duplication number "0 (first type: 0, and second type: 0)" (step S1304). The request destination device then performs the step 5 S1107 shown in FIG. 33.

With the above operations, out-group devices are permitted to play a received content, while prohibited to duplicate the received content to another device.

10 (4) The scope of present invention includes such a modification to update the permitted number of duplications shown by duplication restricting information at a predetermined date-and-time.

To be more specific, the update unit of each device is 15 provided with a clock, and duplication restricting information includes a predetermined date-and-time, a current permitted number of duplications, and a post-update permitted number of duplications. The update unit updates the duplication restricting information at the predetermined date-and-time so 20 that the current permitted number of duplications is overwritten with the post-update permitted number of duplications.

Note that in the case where the permitted number of duplications after the update becomes "0", the update unit erases the content information from the storage unit.

25 Further, although the permitted number of duplications held in one of the in-group devices is updated at the predetermined date-and-time, the sum of all the permitted

numbers of duplications held in each in-group device always remains constant.

Further, in the case where a recording medium acts as an in-group device, the recording medium may not be connected 5 to a playback apparatus when the predetermined date-and-time is reached. Therefore, the recording medium is so structured to have the playback apparatus confirm the predetermined date-and-time at the time the connection is established. Judging that the predetermined time has already passed, the 10 playback apparatus updates the duplication restricting information by replacing the current permitted number of duplications with the post-update number of duplications.

(5) The scope of present invention includes such a 15 modification to duplicate a content to a predetermined device at a predetermined date-and-time.

To be more specific, the update unit of each device is provided with a clock. The storage unit of the request destination device stores content information that is composed 20 of a content and duplication restricting information. Here, the duplication restriction information includes a duplication date-and-time at which duplication is to be performed, a device identifier of the device to which the content is to be duplicated, and the requested number of duplications. When the duplication 25 date-and-time is reached, the update unit generates duplication restricting information that shows the requested number of duplications, and transmits the requested content along with

the generated duplication restricting information to the device identified by the device identifier.

(6) The scope of present invention includes such a  
5 modification that each in-group device is capable of detecting  
a specific content.

To be more specific, in order to detect a specific piece of content information, a request source device transmits to each in-group device, detection information including a content  
10 identifier. On receiving the detection information, each in-group device searches the storage unit of their own and of the recording medium connected thereto in order to detect the content information having a matching content identifier. When  
detecting the content information, the update unit that has  
15 detected the content information transmits to the request source device, a message informing that the content information in search is detected.

In the case where more than one device has detected the content information, the request source device may receive  
20 duplication of the content information from the device that first transmits the message. In one alternative, each in-group device may be structured to transmit the permitted number of duplications along with the message, so that the request source device may receive duplication of the content information from  
25 an in-group device of which permitted number of duplications is the greatest. In another alternative, the request source device may receive duplication of the content information from

an in-group device of which communications bandwidth is broadest, or of which location is closest.

Note that in the case where the requested number of duplications is not fully covered by the permitted number of 5 duplications held by a request destination device, it is applicable to detect all the other in-group devices also having the requested content through the use of the above-described detection capability. Consequently, the request source device may receive from a plurality of the in-group devices, 10 duplications of the content so as to receive permitted numbers of duplications that are equal to the requested number in total.

(7) The scope of present invention includes such a modification that the content information, the common secret 15 information, and the device identifier are stored in the tamper-resistant storage area.

(8) The scope of present invention includes such a modification that content information is encrypted in whole 20 or in part.

(9) As shown in FIGs. 25, 26, and 29, each in-group device in the above embodiment commonly store tables 1135, 1136, and 1137. Yet, the scope of present invention includes such a 25 modification that each in-group device includes different tables.

(10) In the above embodiment, whether to permit content duplication to an out-group device is set using the flag included in the duplication restricting information attached to the content. When content duplication to an out-group device is permitted, the duplication restricting information may further include a permitted number duplications to an out-group device.

That is to say, it is permitted to duplicate the content to an out-group device as long as a requested number of duplications is not greater than the permitted number of 10 duplications shown by the duplication restricting information.

(11) Further, when a content is duplicated to an out-group device, the duplication restricting information held in the request destination device may be updated so that the permitted 15 number of duplications to an in-group device is altered to "0". This modification still falls within the scope of the present invention.

(12) The present invention may be embodied as a method composed 20 of the steps described above, or a computer program for a computer to perform the method, or even as digital signals representing the computer program.

Alternatively, the present invention may be embodied as a computer-readable recording medium having the above computer 25 program or digital signals recorded thereon. Examples of such a computer-readable recording medium include a flexible disk, a hard disk, a CD-ROM, an MO, a DVD, a DVD-ROM, a DVD-RAM, a

BD (Blu-ray Disc), and a semiconductor memory. Alternatively, the present invention may be embodied as the above computer program or digital signals recorded on such a recording medium.

Further, the computer program or digital signals may be  
5 transmitted via a telecommunications circuit, wireless or cable communications circuit, or a network typified by the Internet.

Alternatively, the present invention may be embodied as a computer system composed of a microprocessor and a memory. Here, the memory stores the above computer program, and the  
10 microprocessor operates according to the stored computer program.

Further, the program or digital signals may be transported in from of a recording medium, or transmitted over a network, for example. With this arrangement, the programs or digital  
15 signals may be performed by another independent computer system.

(13) The present invention may be embodied as any combination of the above embodiments and modifications.

20 Although the present invention has been fully described by way of examples with reference to the accompanying drawings, it is to be noted that various changes and modifications will be apparent to those skilled in the art. Therefore, unless such changes and modifications depart from the scope of the  
25 present invention, they should be construed as being included therein.